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The Constancy of the Standard Cells.

Ever since the subject of a final selection of standards for representing the three fundamental units—the ohm, the ampere and the volt—has come forward, physicists have made elaborate reinvestigations of the concrete standards in order to fix on the two of the three which possess in the highest degree the properties for reproducible standards. Various experimenters from time to time have reported certain discrepancies in the e.m.f. observed in standard cells, and opinion abroad has favored a tendency to the treatment of the volt as a unit whose value is to be determined from the ratio of the standard ampere to the standard ohm.

As mentioned in our issue for last week, and as discussed more fully in our present issue, Drs. F. A. Wolff and C. E. Waters have conducted at the United States Bureau of Standards an extensive series of tests with Clark and Weston standard cells which seems to show that the constancy of the e.m.f. of the cells and the ability to construct cells giving accurate indications, depends largely upon the methods employed in preparing the mercurous sulphate, and that when the easily obtainable proper materials are used the e.m.f. of different cells will differ among themselves not exceeding three parts in 100,000. This series of tests is of much importance in showing that, so far as concerns its reproduction, the standard cell is superior to the standard coulombmeter, and that from the point of view solely of accuracy, it is preferable to select for reproduction the ohm and the volt rather than the ohm and the ampere. It cannot be denied that quite independent of the selections which have been or may subsequently be made by international agreement, in ordinary laboratory determinations the standard cell will be preferred to the standard coulombmeter. It is comforting to know, however, that the standard cell, which will be used in any event, has a high order of accuracy.

Central Station Advertising Matter.

Ideas differ radically as to what constitutes good advertising matter, but there are certain cardinal principles dictated by common sense and a knowledge of human nature which cannot be disregarded, but which are apparently being ignored by some central station companies in the expenditure of their advertising appropriations. As believers in central-station advertising, we cannot but protest against misdirected efforts which are sure to be quoted sooner or later to the discouragement of central station companies about to enter the adverising field to increase their sales. The monthly or quarterly bulletin of a central station company can be made a very effective piece of advertising literature or it can degenerate into a kind of perfunctory publication which "has to be got out" once a month. In this connection we cannot but admire the policy of one large company which has no regular interval for publishing its bulletins but comes out with a bulletin on some special subject whenever the

time seems ripe and the commercial department has some effective ammunition to dispose of. However, we do not wish this to be taken as reflecting in any way on the plan of publishing a monthly bulletin, for there are so many good, interesting and effective things to be said in a central station company's monthly bulletin, that it is too bad to pad it up with miscellaneous assortments of clippings on irrelevant subjects. We have in mind one central station bulletin of recent date which in its thirteen pages contains only two pages relating in any way to the use of central station service by the public. There were, to be sure, in addition to these two pages, two more pages devoted to a power-house description, which description, however, is too technical to appeal to the average reader and had so few references to the precautions being taken by the company to secure uninterrupted service that its value as a business getter is questionable. With the exceptions noted the paper was entirely taken up with advertisements and reading matter which were absolutely irrelevant so far as the objects for which the bulletin was published were concerned, the reading being compiled in most part with the shears from daily papers and magazines. We suppose the excuse of the publishers would be that they had to give people a lot of matter not relating to central station service in order to get them to look through the paper and read the matter that did so relate. Such a contention, however, is being daily disproved by the numerous companies publishing advertising matter which is to the point and which is nevertheless read by some of the people for which it is intended. How central station service can be advertised by issuing matter which says almost everything but the things which it ought to say and the things for which it is being published, can accomplish anything in the way of direct or indirect returns is a problem in advertising which we will pass up for the attention of those better versed in the subject than ourselves.

Telephone Engineering.

While in telephone engineering there have been advances in every direction during the past year nothing has been brought forward conflicting to any great extent with the present accepted systems. A general tendency throughout the telephone field to reduce rates and to provide otherwise for the small user has been accompanied by unusually great investment of capital in the telephone plant, and it has been the problem of the telephone engineer to reduce the cost of plant maintenance and operation per subscriber in order that a proper return on the investment may be derived. The growth of telephone density has forced the abandonment of the single large exchange idea for the greater cities, and even for cities of moderate size the possibility of branch exchanges with their consequent trunking must be kept continually in view. This evolution has made trunking one of the most important features of exchange operation. The greatest recent step toward improving interoffice trunking has been to relieve the trunk or switching operator of the responsibility for ringing the called subscriber. This has been accomplished by introducing relays and commutators, so controlling the signaling supply that the ringing is automatically accomplished at the proper time. The duties of the trunk operator for each call are thus so reduced that she can handle a correspondingly increased number of calls. It has at the same time become of prime importance to select a switchboard with a circuit system well adapted to the requirements of the trunking system. In this particular there lies a choice between the "two-wire" and "three-wire" systems. This last, named from the number of individual circuits led through its jack field, separates the talking from the signaling wire, and lends itself most readily to all the requirements of trunk signaling. While there are many large "two-wire" switchboards in use, few are used with elaborate trunking systems, and it may probably be safely said that the three-wire common battery switchboard is becoming the standard.

The automatic exchange has apparently obtained a firm foothold and is now successfully operating in quite a large way. Its critics naturally continue to find flaws, contending that while at first users express satisfaction, this is largely due to the novelty of the system, which causes him to exercise extreme care, and that with familiarity the interest will wear off and careless users will miss the prompting of the operator. As to the semi-automatic exchange, which is also making much headway, and which gives command of the system to the operator who under normal conditions has no direct communication with the subscriber, the criticism is that here again there is the possibility that many errors which she now corrects almost involuntarily, will pile up as counts against this system in practical use. The confession that the systems do give satisfaction to present users detracts from the prediction as to their future state of mind.

In reducing maintenance, the use of cable has proved most beneficial, the liability of this to trouble being much less than open wire lines. Its susceptibility to lightning, however, has brought the matter of protection rapidly to the front, and it is now becoming customary to provide elaborate protection even to the subscriber's premises. There is yet much to be desired along this line, as not only are cables still frequently damaged, but there is a grave question in the minds of some engineers lest the present day elaborate protectors may introduce more trouble than they overcome. The subscriber's instrument has been largely redesigned in the last few years. Box type instruments have had their parts readjusted to increase accessibility and desk instruments are now largely of the "knock-down" type, which permits all parts to be brought quickly into view.

The telephone toll business has kept pace with the growth of local business, both in quantity and reduction of rates. The circuits have been brought up in telephonic efficiency by the use of Pupin coils, which have also made possible the use of smaller wire, and even of cables for long toll lines. Toll lines are also being made more efficient by the duplexing or phantoming of circuits. This system permits of the connection of two circuits together to form a third, each without interference with the other. The phantoming is accomplished through transposition of the two circuits as units, and by the use of well-designed repeating coils. Contemporaneous with improvement of talking efficiency every effort is being made toward improving the "minute" efficiency of toll lines by better operating and more efficient automatic signaling. Considerable success is being had in this direction. Much work has been done on repeaters of late and the indications now are that the micro-telephone type will be ultimately successful. From patents recently issued covering refinements it is evident that the primary defects are being gradually discovered and worked out.

INTERNATIONAL RADIO-TELEGRAPHIC CONVENTION.

The text of the agreement reached by the government delegates to the International Radio-Telegraphic Convention at Berlin last year has recently been published in full, together with its minority addenda, its final protocol and its list of service-regulations or by-laws. The document is of very great interest and importance. It contains 23 articles in the principal agreement, 3 articles in the minority agreement, 7 articles in the final protocol, and 42 in the service-regulations, or a grand total of 75, nearly twice as many as in the famous 39 articles of doctrine and belief. There were no less than 27 countries whose governments sent delegates to the convention, from the Russian Empire, down to little Monaco, whose territory embraces 8 square miles. The western world was well represented by delegates, from the United States, Mexico, Argentina, Chili and Uruguay. The only important coast-line countries not represented were China in Asia, and Peru, Ecuador, Colombia and Venezuela in South America. All the other important maritime countries of the world were represented, but colonies such as Canada and Australia had no independent representation. The convention was not the first of its kind. Wire-telegraph government conventions have been held at regular intervals for many years. One or two preliminary wireless-telegraph conferences of government delegates have also been held during recent years, but this convention at Berlin was the first important gathering and the next is scheduled to occur in four years' time. The convention had become imperative. On the continent of Europe, there are a number of countries huddled together in close proximity, each with its own government, customs and language, and all within long-distance wireless telegraph range. Each country seeks to keep within wireless telegraph communication with its own ships, even when these are steaming in proximity to foreign coasts. In order to keep up this communication each country has to exchange wireless messages between its shore stations and passing ships, no matter what flag those ships may be carrying. Definite payments have to be made for each message exchanged. These messages may have to pass through several countries and government telegraph administrations, so that international agreement becomes a necessity in regard to the regulation of wireless telegraph traffic.

The agreement shows that all of the delegates subscribed to the principle that each and every public shore station is bound to exchange wireless communication with each and every wirelessly equipped ship, and vice-versa, without regard to the system of wireless telegraph used by either. Certain countries—apparently, Denmark, France, Great Britain, Italy and Japan—reserve the right to exempt certain shore stations from public service, presumably for military or naval purposes exclusively. Unexempted stations are bound, however, in their respective spheres of influence to exchange messages with passing vessels on demand of the latter. An attempt was made to establish the further principle that all vessels, wirelessly equipped, should be bound to exchange wireless communications, no matter what their respective equipment systems; but only 21 of the countries represented ratified this principle, including the United States, the countries apparently declining to ratify being Great Britain, Italy, Japan, Persia and Portugal. The first two of these five were hampered by existing agreements with wireless companies, and Italy declared that although adhering to the principle of free ship-and-shore communication, the Italian Government might be unable to ratify the convention until after the expiration of certain existing contracts. Each country reserves the right to withdraw from the convention after due notice, and at the next conference steps are to be taken to introduce colonies and protectorates as individually represented countries, provided that the total number of votes allotted to each country including its dependencies shall not exceed half a dozen.

The development of wireless telegraphy is likely to have a material civilizing influence on nations, judging by this most noteworthy document. Formerly, each country owned its own land, including a three-mile fringe of seawater around its coast, besides all of the atmosphere above that area. Wireless telegraphy, however, involves all countries in one circumambient ether, and the air above each is permeated by undulations emitted by others. All countries are, therefore, brought into virtual contact in the aerial ether, and this tends to promote good fellowship, just as when strangers accustomed to drive in private carriages, are all compelled to associate in the same street-car.

The service regulations adopted are of special interest to electrical workers. A ship must not call up shore, until well within range of a shore station. Each ship takes a three-letter call apportioned by the government to which it belongs. No two ships are to have the same call-signal. The ship, when wirelessly equipped, must have a license, and the operator must also receive a license, after having passed an examination in signalling and in knowledge of the necessary connections, besides having pledged secrecy in duty. A ship calls by the "NK" call signal followed by the call signal of the shore station thrice, then the French word "de" (from) and ending with the ship's call signal. If the shore station gets the call, it acknowledges the same. The ship then proceeds to state in regular sequence her distance and bearing from the station, her course and speed. The shore stations have right of way in determining the order of reception of messages. The international Morse code alone is recognized, so that the American, or Mexican, Morse codes of signalling, seems to be ruled out of order. This is, of course, a proper action, since there should be one and only one code of international Morse recognized. There is no reason, however, why American Morse should not be received, if it is comprehended by the receiving operator. When the three letters PRB are sent by a ship after her call they are to indicate an intention to communicate in the international code of signals. This dread triplet is to be tabooed for all other purposes, and sacredly commandered for the above exclusive purpose. Vessels in distress use the special signal, SOS, repeated at short intervals. This signal is given right of way over all other communications. The normal wave-length of all merchant ships is to be 300 metres, and whatever other wave-length they use they must be capable of using this wave-length. Ships are not, however, to use wave-lengths exceeding 600 metres. Very small ships that cannot attain the normal wave-length of 300 metres may use shorter waves. All ships must be tuned, and must not use more than one kilowatt in sending, except under extraordinary conditions. Complaints may be lodged against ships that refuse communication, and

the licenses of operators or of ships may be revoked by their governments in cases of contumacy.

An international wireless telegraph bureau is established for the purpose of collecting and exchanging information. It seems at first to have been suggested that the delegates should draw lots as to what country should hold this office, the expense of which is divided among all. Later, however, Switzerland was accorded this duty, she being the only important European country unrepresented at the conference, probably because of her inland situation. This selection is a particularly good one, because Berne is the recognized international telegraph center of the world, and has occupied that position for many years. The final results of the convention, even if they have not yet been fully ratified by their respective governments, are the establishment of an international wireless system of exchanging messages over the sea, in one frequency or wave-length, with a definite schedule of charges per word or message, over and above the regular land charges. This alone is a tremendous advance in civilization, even though the system may take years to develop. In addition, a code of wireless etiquette is established for the guidance of wirelessly equipped vessels, intended to promote their general benefit in the prompt transmission of communications. Although no such world-wide agreement can be free from defects and there is room for criticism as to details, we think the general result achieved redounds to the credit of every country represented.

The Storage Battery.

With each passing year the storage battery comes into greater and increasing prominence. At the present time many engineers are nearly as familiar with the lead storage battery as they are with the dynamo, the steam turbine, or other apparatus which forms a salient part of an electrical equipment, and the battery now receives its proper and deserved consideration in nearly every suitable case. With added experience and knowledge has come the discovery that storage batteries are adapted for many purposes which their most enthusiastic exploiters had not even thought of, and other conditions to which they seemed particularly suitable have been found to be better fulfilled by other apparatus. For instance, within recent years a good proportion of the large, alternating-current power stations has been equipped with a storage battery connected across the exciter bus-bars, so that if the source of exciting current fails the battery will continue to supply the field current to the generators. The use in this case is only as insurance against the shutting down of the station, and was hardly contemplated in the earlier days of large alternating-current stations. Considered as insurance against breakdowns, and as a regulator, combined with the ability to carry peaks, they are desirable in most power stations, and where a battery is found working on peak loads, it generally is true that these additional considerations lead to its installation. Cells are now obtainable in this country, in which the electrodes do not "buckle," the active material is firmly adherent, expansion and contraction are provided for, and the life and reliability have been so augmented that their commercial value has been greatly increased. In spite of these improvements, the greater cost of raw material and labor, and the soaring prices of all industrial products, the prices of storage batteries have not increased, but on the contrary are slightly lower than they were two years ago. This is due to the great increase in the volume of business, more advanced methods of manufacture and competition.

A notable change in battery practice, resulting both from competition and improvements in electrodes, is the doubling of the allowable discharge rate on regulation. The duration of individual discharges of regulating batteries is from one to twenty seconds. The one-hour rate—which is four times the eight-hour rate—was for years the maximum allowable rate for these momentary discharges. Within the past eighteen months the permissible regulating discharge has been made equal to the twenty-minute rate, or eight times the eight-hour rate. This reduces by half the size of the battery required for a given load regulation. Batteries installed on this basis are working satisfactorily, and no trouble seems to be apprehended by the makers from this increase in discharge rate, as they are giving guarantees both as to life and performance under these conditions. The applications of storage batteries as auxiliaries on alternating-current systems is markedly increasing. They are used in parallel with rotary converters for the purpose of maintaining constant the load on the supply system and thereby preventing the rotaries from "hunting." More recently they have been applied to alternating-current distribution systems to take up the load fluctuations on the alternating-current lines themselves. A rotary converter or motor-generator is connected to the alternating mains, the battery being connected to the direct-current side of the machine. When the power generated at the power station is in excess of the external load, the excess passes to the battery, being rectified by the interposed dynamo-electric machine. When the load demand exceeds the power supplied by the generating plant, the battery discharges to the alternating lines through the rotary converter and furnishes the additional output required, the rotary converter supplying alternating current of the proper frequency. Difficulties due to the unsatisfactory operation of "inverted" rotaries were at first experienced, but these have been overcome, and the regulation of alternating systems by storage batteries is now an accomplished fact.

The storage battery is the natural consort of the gas engine, and a considerable number of applications in connection with internal combustion motors may be predicted. Engines of this character possess no overload capacity, and operate most successfully under a steady load. Their initial cost is higher than that of other commercial prime-movers. To keep down the size of these engines, and to impose only a steady load on them, when they serve to drive electric generators, the storage battery is particularly adapted. As the realization of this fact becomes more general, the battery trade should be greatly influenced by the volume of gas engine business. The use of a storage battery in parallel with any electrical generating system usually necessitates the use of boosters, and in the few cases, where these machines may be omitted, the performance of the battery would be improved if boosters were installed. An early appreciation of the importance of automatic boosters has led to considerable activity on the part of inventors and designers, as is shown by the Patent Office records for the past sixteen years. Many ingenious schemes have been devised and duly patented, and the usual litigation, which follows in the train of such circumstances, has naturally resulted. The original basic patents

on self-regulating boosters will expire early in the present year. In the meantime numerous variants of the first commercial ideas have appeared, operated and been adjudicated in the courts. The several methods of winding the field coils of the boosters themselves to respond to changes in load conditions and thereby cause a predetermined charge or discharge on the battery proportional to these casual load changes, have all been superseded by the externally-controlled types, of which there are now no less than four varieties. The advantages of the externally-controlled machines over the field-wound types are, ability to use smaller and standard frames, higher efficiency, lower cost and better regulation. With the old field-wound boosters, the maintenance of the generator load within ten or fifteen per cent of its normal value, with external load fluctuations of two or three hundred per cent, was considered good practice. With the externally controlled boosters five per cent regulation is usual and in one case it has been brought within two per cent, the external variations running as high as five hundred per cent.

Motor car batteries have undergone but little change. They still weigh about a pound for 9 watt-hours' output despite the many and variegated promises of lighter and more efficient traction cells. There are some who contend that the possibility of a lighter battery for this service possessing a reasonable durability lies in the better use of sponge lead and lead peroxide and not in lines outside the employment of these active materials. Train lighting batteries have been improved only in the smaller details of construction. These cells are better made than they formerly were. The connecting straps are heavier and strengthened with fillets at the corners; the separators are made up of layers of perforated hard rubber and wooden sheets laid together, and the workmanship generally has been improved. The railway authorities are about equally divided in their preference for rubber jars or lead-lined tanks. Each type of container has its advocates and either is well adapted to the service. There has been a great increase in the volume of battery business for train lighting, not only in the larger number of cars equipped, but also in the number and size of the cells on each car. The present tendencies in battery work seem to lean towards a reduction in the cost of factory production, better workmanship, more carefully designed details, and improvements in the auxiliary apparatus, such as boosters, end-cell switches, automatic protective devices and systems for operating storage batteries on alternating-current circuits. Lower prices than those now ruling cannot be expected unless there is a substantial reduction in the cost of lead, which does not appear probable at the present time. That the field of usefulness of the storage battery will continually increase and that the output of all the factories engaged in the production of accumulators will each year become heavier requires no gift of prophecy to foresee.

Deflection in Wire Spans.

On account of the desirability of employing engineering methods rather than rule-of-thumb approximations in the design of transmission lines, it is becoming more and more important that the factors which enter into the problem be properly understood and their effects adequately accounted for. Our columns during the past year have contained several articles dealing with the various factors of wind pressure, tensile strain in the wires and action on the poles. On page 99 of the present issue Dr. Harold Pender gives extremely simple formulas for ascertaining the effects of temperature changes on the tension and deflection of aluminum and copper wire spans, and the formulas are so arranged that the desired results can be obtained with the minimum of labor after the constants have been selected. The author introduces into the formulas the data relating to copper and aluminum wires, and leaves only the length of span, the temperature change, and the ratio of the resultant of the weight of wire and sleet and of the wind pressure to the weight of the wire, to be substituted for certain algebraic symbols. The temperature change is defined by the conditions under which the wires will be used, while the length of span will remain as a function of the resultant weight, which will depend upon the sleet and the wind velocity. Much information concerning these quantities was given in articles by Mr. A. J. Bowie, Jr., in our issues for August 25th and September 29th, 1906.

Illuminating Engineering in 1906.

Perhaps the most remarkable of all developments the past year has been the great awakening of interest in illuminating engineering. To be sure, in view of the importance of the subject to the electric lighting industry, it has been strange that this interest has not been taken before, but the indifference of the past makes the present interest the more remarkable and gratifying. Within the year the Illuminating Engineering Society has been formed and its growth has been a surprise to its most ardent supporters, its membership at the close of the year being over 800—a record we believe never before equalled by any technical organization of the kind in the first year of its life. A most active part has been taken in the new movement by the central station interests of the country, as it has become generally recognized that men in the commercial departments of these companies must in future have some knowledge of how to advise customers as to how the best illumination can be obtained for a given expenditure. It is gratifying to note that users and makers of illuminating appliances now are paying more attention to scientific testing of such devices, and with the results of these tests to guide them are not nearly as much in the dark as to the best thing to use in a given place as they would have been 18 months ago. As an illustration of the last statement, more photometric curves, showing the light distribution about various illuminants with various reflectors, shades and globes have been published in these columns the past 18 months than appeared during the previous 10 years. Especially has attention been given to reflectors and globes for use over incandescent lamps, because the incandescent lamp occupies the most important place in electric illumination to-day, and with the advent of the new higher efficiency incandescent lamps it is destined to have the field still more to itself, except for large interiors and exteriors where vapor lamps or flaming and luminous arcs are applicable. As has frequently been stated, with good reason, there is more opportunity to increase the efficiency of electric lighting by proper illuminating engineering than by anything short of a revolution in light-producing apparatus. It is gratifying that this is at last being acted

upon, and that by a combination of good illuminating engineering with the revolutionary changes in lamp efficiencies which have been begun, electric lighting in practice will be further in advance of other illuminants than ever before.

Progress of Electrical Science During 1906.

No epoch-making discovery in electromagnetism has been recorded during the year 1906, but a marked growth and development has been witnessed in all branches of that science. Discoveries in science are neither to be predicted, nor to be predicated of labor. They come meteorically, like genius or cataclysm. Growth and development, however, come by effort and will. Progress can be certified in advance on the basis of the number of workers and of the stimuli offered to research. In past generations the stimulus to research in electromagnetism was almost wholly from within, as the result of scientific curiosity to know. It was this eager curiosity that prompted the philosophers of the eighteenth century. In the present generation the stimulus is largely from without, as the result of a keen desire to accomplish and to serve. A large amount of research to-day is carried on for utilitarian purposes, in order to bring new aids to engineering, manufacture and commerce. Scientific curiosity is none the less stimulating and has indeed rather intensified by the change; but the achievements due to demands from co-related sciences and from the arts are predominant. Science is now the fostermother of industry.

In electromagnetic theory, steady development has continued in the electronic hypothesis. By this hypothesis all matter is composed of molecules, molecules of some seventy elementary atoms, and atoms of different numbers and groupings of electrons. All electrons are supposed to be similar, each to be an electric charge, and a minute local deformation in the universal ether. Consequently on this hypothesis all matter is ultimately composed of electricity. The ordinarily observed mechanical inertia of matter is, on this theory, nothing more than the self-induction, or electromagnetic inertia, of the electric currents set up when matter, with its hordes of internal electron charges, is varied in motion. One form of the electronic theory offers a tentative explanation of universal gravitation. Very many and diversified observed facts fall into line with the electronic theory, including a great number of complex phenomena, in electrolysis, in metallic conduction, and in gaseous discharge. There seem to be annually fewer observed conditions that fail to come into line with the modern electronic hypothesis. A recent application of the electronic theory is to the dimensioned formulas of electromagnetic quantities. Until a few years ago all electromagnetic quantities were attempted to be expressed in terms of length, mass and time. More recently it was pointed out that these three fundamental quantities were insufficient for the purpose, and that at least one more was needed in order to form an adequate and logically comprehensive dimensional system. During the last year it has been suggested that the electronic charge of electricity, the seemingly most fundamental quantity in nature, and approximately the 10^{19}th part of a coulomb, might serve as the most convenient and natural fourth dimension. On this basis a new set of dimensional formulas has been deduced, involving length, mass, time and the electronic charge. The system appears to have distinct advantages in connection with the electronic theory.

In relation to the electronic theory, the science of radioactivity has made marked advance. It is now tentatively supposed, although by no means yet demonstrated, that uranium, the substance whose atomic weight is the greatest known, is unstable and that the substance disintegrates with extreme slowness, atom by atom. The disintegration may end ultimately in lead. Intermediate stages of the disintegration may be actinium and radium. It is possible that, assuming this hypothesis to be true, all the lead in the world may have originally existed as uranium. At all events, whether the supposition that uranium eventually decays into lead is warranted or not, there seems to be no longer any doubt that radium is a substance which throws off electrons by the explosive disintegration of its atoms. The question has naturally suggested itself, without yet finding an answer, as to whether the very heavy atoms between uranium and lead are the only ones that are unstable, and whether a similar process of disintegration may not be occurring with extreme slowness in other and lighter atoms, the violence of their disruption being possibly insufficient to make the phenomenon recognizable.

Much magnetic investigation of a terrestrial character has been carried on during the year, and a recently announced redetermination of the northern magnetic pole has placed it in King William's Land not far from the position located in 1831. International agreement in concrete standards of electromotive force, resistance and current has steadily been promoted during the year, under the auspices of a governmental international conference. The National Bureau of Standards at Washington continues to promote this cause by its researches on the steadiness of e.m.f. in standard cells, as affected by methods of manufacture, and in co-operation with similar institutions in Europe. It would seem as though standard cells could soon be standardized to within a few microvolts. The powerful influence in promoting the applications of science effected by national institutions like the Bureau of Standards is indicative of the recently manifested tendency of scientific work to be associated with national activities. The rapid industrial growth of Germany is believed to be due in appreciable measure to the operation of scientific activities under the direction of the government, as well as to the careful fostering of technical education by the German Government. In the United States the Federal Government does not directly support technical education, but indirectly it does much for applied science, in surveys, irrigation, the weather bureau, the agricultural experimental stations and the Bureau of Standards. The Carnegie research fund, administered in Washington, strengthens the tendency of scientific co-operation and unification. This influence of the Federal Government upon the organization of scientific effort may not be for the best interests of discovery, but is undoubtedly for the best interests of growth and development in science and its applications.

The steady average increase in high tension for long-distance power transmission has caused much attention to be devoted during the past year to methods of insulation and the properties of insulators. The growth of wireless telegraphy has caused much work to be done in the science of electromagnetic waves. Steady progress has also been made in methods for sustaining electric oscillations in wireless telegraph antennas. Wireless

telephony has also made strides, both in range and in articulation. In telegraphy progress has at last been made in the direction of automatic methods from typewriter keyboard at the transmitter to typewriter printing at the receiver, whereby Morse code is eliminated from the entire process. Coincidently with this improvement, the Wheatstone automatic transmission system is disappearing from this country. The Wheatstone transmitter was a high-speed apparatus that held its own for many years. Its defect was, however, that it required Morse code perforation at the sending station and also transcription from Morse code into the vernacular at the receiving station.

ELECTROCHEMISTRY IN 1906.

The remarkable rapidity with which new and more efficient incandescent lamps have recently appeared—the osmium, tantalum, zircon, graphitized carbon, tungsten, osmin, osram and helion lamps—furnishes a striking example of what electrochemical methods can accomplish in research work when properly applied for specific ends. It is true that few will class the making of filaments as an electrochemical art. The electrical engineer, like the general public, is apt to be interested in a lamp and its behavior as a finished article only, while industrial electrochemists are apt to look on filament manufacture as laboratory work, since the output is not measured in tons per day. If, as Dr. Sharp recently said, "the electric lighting industry is face to face with a change of almost revolutionary character," then the quietly working electrochemists in the laboratory have been the Voltaires and the Rousseaus of that revolution.

The electrochemical industries generally recognized as such have presented an equally creditable record. In the case of graphite, formerly only hard graphite was produced artificially, which had a restricted field of usefulness; a recent invention by Mr. Acheson of a method of making soft graphite in the electric furnace appears to open a large field of new applications and will put natural graphite decidedly on the defensive. Of ferro-alloy, large quantities were continued to be imported last year from Europe, but the home production is increasing decidedly and last year ferro-silicon was produced for the first time on a commercial scale in this country. In the manufacture of high-class tool steels we can record a further progress in the application of the electric furnace, both of the Héroult type and of the Kjellin-Colby induction type, in this country as well as in Europe. It is undoubtedly only a question of time when the expensive crucible process will be superseded by electric furnace methods. It is too early to say which of the electric furnace methods will prevail in the end and whether such methods will find commercial application for the production of other metals than high-class tool steels. With respect to the problem of the reduction of pig iron from ore, the experiments of Héroult and Haanel in Sault Ste. Marie have given us the first exact figures as to energy consumption, which are not entirely satisfactory except where the cost of electrical energy is very low. The problem is to be taken up in the near future on a commercial scale in California with cheap hydroelectric energy. One electric furnace industry which in the past has been considered of a somewhat experimental nature, has attracted much attention during the past year, namely, the manufacture of calcium cyanamide. The starting materials are calcium carbide and nitrogen (from the air). The electric furnace reaction yields calcium cyanamide, which may be either worked up into cyanide or may be used directly as a fertilizer. The first large commercial plant was erected in Italy.

Calcium cyanamide is interesting in two respects. It represents, first, a new and important market for calcium carbide, and second, a novel solution of the problem of fixation of atmospheric nitrogen for the production of fertilizers. In connection with the latter matter the most important achievement of the past year was the commercial success of the Birkeland-Eyde process in Norway, using the more direct method of combining the nitrogen and oxygen in air by means of electric discharges. It should not be overlooked, however, that in the successful Norwegian works the electric energy generated from water is extremely cheap, the cost of the hp-year being quoted at $4 to $5. The production of ozone for sterilization of water seems to have made little headway, probably on account of the high cost. On the other hand ozone is used commercially for bleaching flour in the West and it has recently been stated that for this purpose a mixture of ozonized air and of nitrogen oxides is still more advantageous—that is air treated both by means of the silent discharge and by means of the arc discharge.

Among electrolytic processes copper refining was easily first, which is only natural in view of the enormous activity in copper metallurgy during the past year, and the phenomenal selling price of the metal. It may here be remarked that the capacity of the large Eastern copper refineries has about doubled during the last five years. For refining lead the Betts electrolytic process is now operated in three plants, the latest one being in this country near Chicago. Both gold and silver are now refined electrolytically in the United States mints in Philadelphia and Denver. The situation in the electrolytic caustic soda and chlorine industries has changed little, though the use of electrolytic chlorine for detinning tin scrap and waste cans (as a substitute for the electrolytic detinning process) has recently attracted some attention. The electrolytic production of hypochlorites or bleaching liquors for sterilizing or bleaching purposes is making no headway whatever in this country, while we have witnessed a decided revival of the same process during the past year in several English municipal works. The aluminum industry is flourishing, the demand being greater than the supply. The court decision sustaining the Bradley patent proved to be a blessing in disguise for the sole producer in this country of aluminum, which now operates under it, since it now protects the monopoly for two more years, the Hall patents having expired. For the manufacture of sodium, Ashcroft has proposed a new process which is being tried in a plant in Norway. Its essential point is the use of cheap sodium chloride instead of sodium hydroxide as starting material. If the process proves successful, the cost of making metallic sodium should be considerably reduced and sodium might become available for various purposes (like Mr. Betts' composite conductor) for which it now seems too expensive. While in this brief review we could only touch on the most important points, enough has probably been said to show that electrochemistry and electrometallurgy have shared during the past year in the general prosperity.

Northwestern Electrical Association Programme.

The programme for the convention of the Northwestern Electrical Association to be held at the Coliseum, Chicago, January 16, 17 and 18, 1907, as arranged at present writing, is as follows: Wednesday, January 16—Morning session at 10 o'clock.—Roll call; reading of minutes; president's address; secretary and treasurer's report; committee reports; applications for membership and miscellaneous business. Wednesday afternoon session—"Enthusiasm," by George E. Legler; "Profitable Co-operation," by J. Robert Crouse; "Premiums to Employes," by Ernest Gonzenbach. Thursday morning session—"Some Characteristics of Alternating-Current Motors in Which the Central Station Man is Vitally Interested," by C. W. Bergenthal; "Producer Gas Power," by Prof. Richter; "Outline Lighting," by Homer Honeywell; "Some Phases of Smaller Central Station Management," by H. H. Scott; "Uniform System of Accounting for Small Companies," by Fred W. Insull; "Some Points on Illuminating Engineering for the Small Central Station," by J. R. Cravath.

On Thursday evening there will be a joint meeting with the Chicago section of the Illuminating Engineering Society. Members of both organizations will dine at the restaurant in the Coliseum and the discussion will proceed immediately after dinner. The subject will be "Street Lighting," the points to be taken up being large versus small units, reflectors for street lamps, and new street lamps. On Thursday morning two papers are on the programme: "The Trend of Improvements in the Design and Operation of Boiler Plants," by A. Bement and "Warrantable Expense for Meter Testing," by O. J. Bushnell. This session will close with the election of officers.

Electric Street Railways in Massachusetts.

The electric street railways of Massachusetts for the year ending September 30 carried passengers equal to about seven times the population of the United States. The gross earnings were $33,955,447, an increase of $6,914,156 over the previous year, while net earnings, $8,199,561, showed a decrease of $572,471. Dividends amounting to $2,159,321 were paid by only 29 companies out of a total of 92.

On their railways, land, buildings and equipment the railways place a book value of $133,357,315, of which the cost of railways represents $75,261,295; equipment, $34,927,226, and land and buildings, $23,168,795. The capital stock of all of the 92 railways amounted to $72,187,200, an increase over 1905 of $1,860,215. The number of car-miles run was 113,205,945. The number of miles of railway operated was 3,307.2 miles. A total of 7,318 cars were operated, while the aggregate number of employes was 17,134. Only three persons were killed out of an enormous total of 572,128,730 persons who used the trolleys, while 5,156 persons were injured.

The following table shows the more important operations of the Massachusetts street railways for the years ended September 30, 1906, 1905 and 1904:

	1906	1905	1904
Gross earnings	$33,955,447	$27,041,291	$26,207,246
Net earnings	8,199,561	8,772,032	7,809,956
Dividends	2,819,404	3,174,505	3,214,496
Capital stock	72,187,200	70,326,985	68,542,038
No. passengers carried	572,128,730	532,731,013	520,056,511
Car miles run	113,205,945	109,258,739	107,897,456
Miles operated	3,307.2	2,668.5	2,654.3
Persons employed	17,134	16,479	16,519

Worcester Polytechnic Institute.

The new electrical engineering laboratories at the Institute, which were described in our issue for June 16, 1906, are now nearing completion, and will be ready for the accommodation of students during the spring of 1907. It is stated that the Institute will then possess the largest laboratories exclusively for electrical engineering to be found in any college in the world. The Institute has been a pioneer in many features of engineering education. The first institution to provide workshops on a large scale for the training of engineering students, it has always maintained its facilities and courses in shop training on a broad basis. One of the first, and at present one of the comparatively few, colleges to provide instruction in electrical engineering design, the Institute offers courses in the practical design of electrical engineering apparatus and systems, under the direction of men experienced in engineering work of this character. The first college in the country to establish a chair of Electric Railway Engineering, the Institute is a pioneer in the development of courses and facilities for this important branch of electrical engineering. The highest potentials ever reached, at common engineering frequencies, have been secured by equipment developed by the electrical department, and in the study of phenomena involved in long distance power transmission at high potentials, the Institute is a pioneer, and possesses facilities which are probably not excelled elsewhere. With the new laboratory the Institute will be in position to make a new record in electrical engineering instruction.

The International Wireless Telegraph Convention.

At the Wireless Telegraph Convention which was held in Berlin during last October, a "Final Protocol" was arranged by the representatives of the following countries: The Argentine Republic, Austria, Belgium, Brazil, Bulgaria, Chili, Denmark, France, Germany, Great Britain, Greece, Hungary, Italy, Japan, Mexico, Monaco, the Netherlands, Norway, Persia, Portugal, Roumania, Russia, Spain, Sweden, Turkey, the United States of America and Uruguay. According to the agreements, which is placed in the form of 23 articles, coast stations and ship stations are bound to exchange radio-telegrams reciprocally without regard to the particular system of radio-telegraphy adopted by these stations. Notwithstanding this provision, however, a station may be appropriated to a service of public correspondence of a restricted character, determined by the object of the correspondence, or by other circumstances independent of the system employed.

It is arranged that the working of radio-telegraph stations shall be organized, as far as possible, in such a manner as not to interfere with the working of other stations of the kind; and that radio-telegraph stations are bound to accept with absolute priority calls of distress from ships, to answer such calls with similar priority and to take the necessary steps with regard to them.

The provisions of the convention come into operation on and from July 1, 1908, and remain in force for an indefinite period or until the expiration of a year from the date of denunciation.

All of the above-named countries, with the exception of Great Britain and Italy agreed to 42 additional regulations dealing with the service operation of the wireless equipments. According to these regulations the choice of apparatus to be used by the station is unrestricted, but only two wave-lengths, namely 300 and 600 meters, respectively, are allowed for general correspondence; for special long-distance service each Government may authorize the use of wave lengths btween 600 and 1,600 meters. The normal wave length for ship stations is 300 meters. Each ship station must be installed in such a way as to be capable of using this wave length. Other wave lengths may be used by these stations on condition that they do not exceed 600 meters. Ships of small tonnage, which it would be materially impossible to equip with plant producing a wave length of 300 meters, may be authorized to use a shorter wave length.

Ship stations must be licensed by the country whose flag they fly. They must use a syntonized system working with power not exceeding normally 1 kw, at not less than 12 words per minute, and they must carry a certificated telegraphist bound to secrecy. The order of precedence for telegrams is (1) Messages to or

from ships in distress; (2) government messages; (3) service telegrams and (4) private telegrams. There are in addition regulations as to the calling and responding of wireless stations, order of transmission, the division of charges and the usual minutiæ of a telegraph service.

Electrolytic Lightning Arrester.

At the December meeting of the American Institute of Electrical Engineers, Mr. Ray P. Jackson, after having discussed lightning phenomena by means of a mechanical analogy, described a type of lightning arrester which is stated to possess characteristics to render it ideal in many respects. What is needed for lightning protection is a device that will hold the operating pressure at all times, but will furnish such a free vent that no pressure much above the normal can be maintained, no matter how suddenly such abnormal pressure may occur. The author stated his belief that such a device has been found in the aluminum electrolytic cell.

In certain electrolytes, aluminum forms a non-conducting film on its surface. This film is very thin, comparable in dimensions to a wave length of light—but in a suitable electrolyte will withstand a voltage of from 380 to 400. Above this voltage, the film will be punctured with myriads of small holes letting a large current through, but resealing again as soon as the pressure is reduced. The equivalent spark gap of such a cell is a function of its dimensions, and it is a simple matter to make a unit for 10,000 volts which will have an equivalent gap representing 12,500 volts. If a gap which will also break at 12,500 volts be placed in series with the cell unit, the equivalent gap of the combination will still be approximately 12,500 volts. In other words, the severest discharge from a condenser representing several miles of line and charged to 50,000 volts, will pass through the device without a potential of more than 12,500 volts existing over its terminal.

Apparently this cell can be connected in series with a suitable gap between each line and ground, and will suppress all abnormal rises of potential at that point. As to the kind of gap, a non-arcing multigap has been found very satisfactory while a small horn gap seems to work nearly as well. The power current taken being less than one ampere, the arc rises a few inches on the horn and goes out quietly. At this time no statement can be made as to which form will prove the more desirable.

The current taken by the device may be divided into two parts and called for convenience "condenser" and "leakage" currents. They both exist at all times when an alternating electromotive force is applied, and one is wattless while the other represents power. As the voltage is increased, both the condenser and the leakage current are increased, but during the period while the electromotive force is highest, there begins to be increasingly large leakage current. As the voltage is still further increased a very acute peak develops near the maximum point on the electromotive-force wave. A surge or electromotive force peak from any other source is allowed to pass and relieve the line, exactly as in the case of a safety valve, while the power current, which can follow, is insignificant.

The author said that the electrical characteristics of this device are ideal for the purpose, but there were many mechanical difficulties met with in making it in a form suitable for commercial use. Nearly all the difficulties have been overcome, but an endeavor is being made to test out all possible points in service.

The discussion of the paper was opened by Mr. Ralph D. Mershon, who outlined the difficulties encountered in studying the phenomena of lightning. Lightning phenomena cannot be reproduced directly and their effects cannot conveniently be measured. In spite of all the experimental work which has been done, the nature of lightning is as yet unknown. The speaker expressed the opinion that it is not possible to determine the action of choke coils by laboratory tests. Although a slight amount of protection is afforded by choke coils they are very expensive and in most cases it is preferable not to use them, but to use instead low resistance lightning arresters, and to provide extra insulation for the end turns of transformers and other devices which are to be protected. An excellent scheme in the arrangement of protective devices is to place several arresters in parallel, having the air gaps of the arresters arranged for successively increasing discharge voltages so that if the excess voltage is moderate only one arrester will operate, while a greater increase in voltage will cause two and a still greater will cause three to operate, thus placing a decreasingly smaller resistance to ground according to the excess of voltage to be taken care of. The electrolytic arrester described by the author seems to possess most excellent characteristics under test conditions. Perhaps it will prove the ideal arrester for service conditions.

Dr. C. P. Steinmetz discussed in detail the four elements which must be combined in a successful lightning arrester, namely, resistance, inductance, spark gap and circuit-opening device. The choke coil inductance cannot protect against low frequency surges, but it does afford a considerable protection against high frequency oscillations. The data obtained from laboratory tests cannot be considered as generally applicable in all cases, but as specific and applying merely to the conditions under which the tests were made. The value of inductance which a choke coil must possess in order to protect a transformer cannot be determined by measuring the increase in voltage along, say, 200 turns, because such measurement does not afford a proper indication of the increase along merely the first turn. Tests made of the maximum voltage across the first turn and the decrease of such maximum with increase of the inserted inductance in the choke coil would indicate a very much lower value for the inductance of the choke coil than would be the case if such tests were made with 200 turns. When the line voltage is first impressed upon the transformer, at the instant of closing the switch the total voltage is impressed upon merely the first turn. At a certain instant later the total voltage is divided between two turns and still later the voltage is divided beween three turns, etc. If, however, an inductance coil is inserted in series with the transformer, when the circuit is first closed the total voltage is first absorbed by the reactance coil, and later it is divided between the choke coil and certain turns of the transformer proportional to the relative impedances of these circuits. Thus, if the choke coil possesses an impedance equal to that of the first turn of the transformer, the maximum voltage to which the first transformer coil will be subjected will be one-half of the voltage of the line, while the choke coil itself will be subjected to a maximum of the full voltage of the line. Dr. Steinmetz showed that when the frequency is extremely high the choke coil ceases to act as a reactance on account of the condenser effect of one turn upon each of the adjacent turns. Thus the flow of electricity is transferred from one turn to the next through the electrostatic capacity of the intervening dielectric without passing around the individual turns of the coil. The choke coil should, therefore, be so constructed as to possess a minimum of electrostatic capacity between its individual turns and a maximum of magnetic induction for each turn included. Below a certain frequency, which depends upon the electrostatic capacity of the turns, the choke coil adequately acts as an inductance; at a very low frequency the coil ceases to protect on account of the fact that the inductance has relatively little effect at such frequency. Between certain ranges of frequencies, however, a choke coil affords considerable protection to the apparatus. In regard to the resistances which should be connected in series with lightning arresters, it may be stated that, so far as protection is concerned, the smaller the resistance the greater will be the protection. Thus the greatest possible protection would be given with zero resistance. For the purpose of interrupting the dynamo current a certain amount of resistance is absolutely necessary, so that one is compelled to select a certain mean value of resistance. The suggestion by Mr. Mershon concerning the use of many gaps in parallel, the discharge voltage

resistances in series with the gaps being graduated, is an excellent one. This method can be carried out by combining all of the gaps in series and all of the resistances in series so that common gap paths and common series resistances can be used for all of the gaps. The final development of this method leads to the multigap arrester with shunted resistance, which is a form of arrester now in commercial use.

Mr. Percy H. Thomas outlined the facts upon which the variation in potential along the transformer turns depends. This variation is governed largely by the electrostatic capacity of the dielectric separating the individual turns and also that between the turns and the core of the transformer. Thus when the voltage is first impressed upon the transformer a miniature current first charges the little condenser formed by the first turn and the second turn with the separating dielectric, and the potential of this condenser is immediately raised to the full value of the impressed voltage. Gradually the potential is distributed and absorbed along the full number of turns of the transformers. In selecting the reactance it is necessary to use different values for the different conditions to be encountered, and it is not possible to use one definite value of reactance for all conditions. The resistance-fuse type of arrester, when certain numbers of them are connected in parallel, gives excellent results, and observations have shown that no rise of potential is produced when such arresters discharge, because the arrester circuit is always open at the zero of the wave.

Prof. E. F. Creighton reported the results of some tests for the determination of the equivalent needle gap of resistances. It was found that the equivalent gap does not vary directly with the measured value of the resistance. Observations seem to show that the equivalent needle gap varies with the impedance in circuit rather than with merely the resistance. Thus, even when the resistance is decreased to zero the equivalent needle gap has a finite value, due to the remaining reactance of the short-circuiting device. The electrolytic type of arrester undoubtedly possesses the excellent characteristics claimed for it by the author. Certain of these arresters have been in use during the past season on a 30,000-volt circuit, and they have shown themselves to operate with entire satisfaction. It has not been thought desirable to give out a description of these arresters until they have been placed in general commercial use.

Mr. H. P. Alverson stated that an experience of several years with lightning arresters in the neighborhood of Niagara Falls had shown that the low equivalent arrester with choke coils placed at the station had so protected the equipment that no interruptions of service had occurred. Mr. P. M. Lincoln remarked that it is exceedingly hard to collect data concerning lightning disturbances. Such data can be obtained by observations made at the time of the stroke, by the results noted on the arresters, or by certain courses of reasoning as to the possible effects from certain assumed causes. The most satisfactory method is by producing lightning artificially and making certain series of observations by changing the conditions of test. The problem connected with the installation of lightning arresters is one which represents a conflict between the protection of the apparatus or the protection of the service. Many engineers prefer continuity of service with an occasional destruction of minor apparatus, rather than perfect immunity from destruction with certainty of interruptions at various times.

Commercialized Electrical Engineering.

An article that has attracted considerable attention in electrical circles appeared last week in the New York *Evening Post*. The underlying assumption that the electrical arts are standing still and that there are only two Richmonds in the field, will amuse if not instruct, while the references to the Subway, being specific, are open to flat contradiction—as well as to change and improvement. The article is quoted in full below.

"Talk about commercialized politics," said a civil engineer the other night, "or the commercialized theatre, or press—why, none of them can hold a candle to commercialized engineering." In explanation he averred that his profession is suffering from the evils of monopoly. A few great corporations—in electrical engineering there are practically but two—not only control nearly all the work done, but dictate the technical methods to be followed. The result is the raising of almost insuperable barriers to new men and new ideas; the practice becomes routine and stodgy; the absence of real competition works the same harm to engineering that it does to any other pursuit."

It is certainly an important question which is raised by this complaint from within the engineering ranks. We know that this point of view is not isolated. Many engineers would agree in general with the impetuous critic whose language is cited above, even if they might regard his indictment as too sweeping. On the professional side it is a matter for engineers themselves to discuss. What the relations of special talent should be to employing corporations, what the obligations of a man to the severe demands of science when they are in conflict with mere money-making—these topics can be most fruitfully debated by those set for the maintenance of a high standard of engineering ethics. But the public is deeply concerned in the practical effect of it all. If engineering has become so commercialized that we are not getting the best possible work, it is of the highest consequence that we should know the causes and find, if possible, the remedies.

The process of setting about any large electric undertaking, for example, is pretty well known. Promoters and their engineers have to go to "headquarters"—we mean to one of the two great corporations which are gradually absorbing the more important business of this sort. They are, admittedly, excellently equipped. No one so ready to "handle" an attractive scheme. But first, of course, you must get engineering approval—meaning their own engineers. Next, you will be referred to a subordinate company of theirs, which is designed to look after the finances. Thus one hand washes the other. To get the backing of the big corporation you must previously find favor with a certain firm of engineers, and also make arrangements to float your securities through a given bond and stock concern. This makes the business very complete, to be sure; puts at the disposal of the inquirer facilities which he could find nowhere else; but the questions of cost, excessive or otherwise, and of getting the best obtainable practice, remain to be considered.

We will say nothing of financial complications, though it is obvious how easily they may arise. As outsiders we are more concerned with the practical result of this commercial organization of engineering, with its inbreeding of talent and its stereotyping of method. It is easy to see, theoretically, that the tendency would be to make even able technicians lazy and perfunctory. Why should they bestir themselves, so long as no competitor is in sight to show the better way and take their work away from them? Monopoly is the great discourager of effort. We may be sure that it will work its deadening effects in a profession as fatally as in trade or manufacture. If pressure from without does not compel the adoption of the most advanced methods, and the putting out of the finest possible product, professional pride will prove an inadequate motive. The only way in which to make even highly trained men get out and hustle, is to pit them against others who will take their jobs from them if they are not on the alert.

The matter comes closely home to the bosoms of New Yorkers in the continually agitated questions about the equipment of the Subway. Is it the best that could have been devised? In one particular, at least, the answer of the man in the street is exactly the same as that of independent and competent engineers. The pattern of car adopted—especially the wooden cars, with their narrow platforms making a perfect *cul de sac* for the crowds—was far from the best that could be made. As soon as experts laid eyes on them, their foredoomed failure was plain. They were far inferior to the cars already

in use in the Boston Subway; they profited not in the least by the experiments of the Illinois Central, for example, in building a type of car fitted to handle the large suburban traffic at Chicago. In a word, the model taken for the Subway was practically obsolete. Its inadequacy could have been foreseen before a single car was set running.

Now, how did this serious mistake come to be made? We speak from no personal knowledge, but we only report the opinion of impartial and skilled men who have looked into the matter, when we say that the root of the trouble was the stolid sense of monopoly on the part of the company furnishing the equipment. They had no rivals to dread; they had their own standardized methods of manufacture, and did not propose to depart from them for the public convenience. What their engineers might have suggested, their financiers vetoed. If this be true, it is certainly a lamentable demonstration of the vices of commercialized engineering.

CURRENT NEWS AND NOTES.

AUTOMATIC CIRCUIT-BREAKERS.—At the next meeting of the Electrical Engineering Society of Columbia University, to be held at 8.15 p.m., Wednesday, January 16, in Room 301, Engineering Building, of the University, Mr. W. C. Jessup, of the Cutter Electric & Manufacturing Company, will present an illustrated paper on "Automatic Circuit-Breakers and Their Uses." All interested are cordially invited to attend.

GREAT CENTRAL STATION GAIN.—The New York Edison Company finds that, according to the figures now available, its net gain for 1906 is in excess of 1,000,000 equivalents of 16 cp. This is undoubtedly the largest gain on record in the history of the central station industry. The company has circulated its *Bulletin* freely, has advertised and has kept its "Follow-up Department" busy. This department has sent out about 1,000,000 pieces of printed material, so that "printers' ink" shows its value in a corresponding number of new consumption "outlets."

A NEW BULLETIN.—The field of central station literature has been enriched by the appearance of *Light*, issued in the interest of electrical development by the United Electric Light & Power Company of New York City, of which Mr. Frank W. Smith is the energetic and successful secretary. This company furnishes the Borough of Manhattan with its supply of alternating current and does it well, as many of the articles and illustrations in this clever little monthly testify. The bulletin is a novelty in being about half the size of those in ordinary use, but it is evident that no effectiveness is lost by this lesser bulk. The bulletin is edited by Miss Beckwith, who has already done excellent work in the same field of technical literature, and whose helpful article on electric signs in our last issue was graced by two illustrations from photographs of new and striking signs, loaned us by the United Company, and appearing also in its January bulletin.

THE ENGINEERING BUILDING.—The United Engineering Societies' Building is now so far advanced to completion that the American Society of Mechanical Engineers and the American Institute of Mining Engineers have already moved into their new offices, and other associated societies are beginning to take up their quarters. On January 8 the Mechanical Engineers held their first monthly meeting in the new building, when President F. P. Fish, of the American Telephone & Telegraph Company, read a most interesting and valuable paper on "The Ethics of Trade Secrets in Relation to the Patent System." The main auditorium was used for the occasion, and nearly 1,000 persons were present. Many societies were represented in the audience by their leading officers, including President Williams, of the National Electric Light Association, and President Condict, of the New York Electrical Society. The acoustics, lighting and ventilation of the hall were found admirable, while its simple, stately architecture and decoration evoked universal praise. A good deal of work has still to be done on the building, but it is now evident that it will be absolutely finished in every detail for the dedicatory exercises in April.

C. E. D. A. LITERATURE.—The Co-operative Electrical Development Association has issued in its regular pamphlet form the "honorable mention" paper by Mr. C. N. Jackson on central station business getting for cities of 50,000 population and under. These papers prepared for competition and presented to the National Electric Light Association have done a great deal of good and Mr. Jackson's paper is in the first rank for suggestiveness and practical value. The central station manager must indeed be dull who cannot derive benefit from the ideas presented for trial or approved in successful practice.

A. I. E. E. MEETING.—The two hundred and thirteenth meeting of the American Institute of Electrical Engineers will be held in the Auditorium of the Engineers' Building, 33 West Thirty-ninth Street, New York, on Friday, January 25, 1907, at 8.15 p.m. The following paper will be presented by Messrs. Lewis B. Stillwell and Henry St. Clair Putnam: "Substitution of the Electric Motor for the Steam Locomotive." The paper will include: 1. Presentation of certain facts established by experience in the operation of elevated, subway and interurban lines by electricity. 2. Discussion of comparative cost of operation by steam and electricity applied to railways in operation, and including both passenger and freight service. 3. The importance of standardizing electric railway practice. 4. The question of frequency in the operation of railways by alternating current. Members of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the New York Railroad Club and the Transportation Club have been invited to attend.

THE LONDON POWER SCHEME.—Discussing the scheme to embark the London County Council on a $47,000,000 power scheme, the *Outlook* of that city says: "It is a cardinal principle of economics to encourage private enterprise in all speculative undertakings and let those who choose risk their money. This principle was provided for in the original electric light legislation which gave the companies power to apply for parliamentary charters and to establish electric undertakings at their own expense, subject to the proviso that at the end of forty-two years the local authority might if it chose buy them out; that is to say, if the industry should in time pass beyond the stage of speculative enterprise the community through the local authority might step in and purchase the undertaking, but good time must be allowed for the purpose both in order to encourage private enterprise and to enable the community to make sure that the speculative commercial stage has passed. Now the electric industry is to-day in just that early stage when it should be left to private adventure. The County Council itself, by its talk of bringing electricity into every home and transforming industrial London through electric power, proclaims the embryonic state of the industry, and that proclamation is fatal to the proposal for municipalization. As the potentialities of electricity have widened enormously since the days when the existing companies came into the field as pioneers, it is only right now, when the whole question of electric supply is being debated *de novo*, that the existing companies in the new era which they propose for themselves should be allowed, as is suggested in the bill coming before Parliament, to start afresh and all together and with another forty-two years' charter. At the end of that time the community through the local authority may, if it chooses, take over what will then, at any rate, be a well-tried industry."

TELEPHONY IN BOSTON.—By a vote of 11 to 2 the Boston Board of Aldermen has passed over the Mayor's veto the order granting to the Metropolitan Home Telephone Company a franchise authorizing the company to establish, operate and maintain a telephone system in the City of Boston. One of the opponents said that the franchise thus given away for nothing had a value of $500,000. Mayor Fitzgerald is to fight the matter in the courts.

DUTY ON NIAGARA CURRENT.—It is announced from Toronto that the Canadian Government has decided to impose an export duty on electrical energy from Niagara Falls with the object of obtaining for Canadian consumers at reasonable rates all power which they require. It will be provided that a company which complies with the regulations which the Government will lay down may be relieved from the payment of export duty. The Dominion Government will insist upon the Canadian market getting all that it needs; otherwise the export duty will be made effective. The duty will be fixed by the House of Commons, and will probably be $10 a horse-power.

YUKON WIRELESS TELEGRAPHY.—It is stated from Ottawa, Canada, that the De Forest Wireless Telegraph Company has submitted a proposition to the Dominion Government for the installation of wireless telegraph stations to bridge over the dangerous portion of the route on the Government telegraph system between Ashcroft and Dawson, which by reason of avalanches and windstorms is so liable to interruption in winter time. The company wants a subsidy of $50,000 for the installation of its plant and a further subsidy of $50,000 for each year it is in operation. The De Forest people undertake to cut the existing tolls in half, which at the present time are $4 for ten words from eastern points. The annual deficit in working the Yukon line is over $100,000.

WHEN THE GAS GAVE OUT.—A telegram from Cleveland of January 5 says: "The natural gas supply, which was completely cut off in this city early yesterday, following the blowing up of both mains leading from West Virginia to Cleveland, was partially restored this morning. The East Ohio Gas Company succeeded in repairing the break in its 12-in. main shortly after daybreak, which furnished consumers in this city a very limited supply of fuel. The 18-in. main was repaired at noon and the city restored to its normal supply of gas, ending the worst famine since natural gas was piped to this city from West Virginia, four years ago. Physicians say many deaths from pneumonia and kindred complaints will follow." It is said that similar conditions in Indiana and the Middle West have been a great stimulus to electrical development.

STREET LIGHTING SPECIFICATIONS.—A new committee, just appointed by President Williams, of the National Electric Light Association, has been created for the purpose of formulating a model contract and specifications for street lighting. A great many inquiries have been made for such a contract—one that would be fair both to the lighting company and to the municipality, and one that would permit of changes in the form of illumination, as new developments were made in the art, on a basis satisfactory to both parties to the contract. The personnel of the committee is exceptionally strong, the members being Messrs. Dudley Farrand, Louis A. Ferguson, Paul Spencer, Charles P. Steinmetz and A. E. Kennelly, and very useful results are looked for in the report to be presented at the thirtieth convention of the association, May or June next.

ST. LOUIS LIGHTING.—The supervisor of city lighting, St. Louis, Mo., in a report from his department for the calendar year of 1906, estimates the cost of lighting the streets to have been $567,391.60. In 1905 it was $497,708.20. The lighting department is open twenty-four hours a day every day in the year. Relays of men are kept at work to handle any trouble that may arise. The cost of lighting public buildings, those under contract only, was $25,223.75. There were in operation on the streets 1,053 arc, 773 incandescent and 17,254 mantle lamps. In public buildings there were 17,062 electric lamps. Twenty-nine miles of conduit were constructed by electric light and power, telephone and telegraph companies, while 1,080 conduit applications, 3,233 pole, 6,860 wire and 5,342 complaints of all kinds were received, and 6,021 poles were erected by telephone, telegraph, electric light and power companies.

PRIVATE ENTERPRISE.—In connection with the opening in London of the new tube of the Underground Electric Railways Company Sir Edgar Speyer, the president, says: "We have nearly finished our work—the last tube, the Charing Cross, Euston, and Hampstead—will be completed in June and we shall then have given London a system of lines that will transform the traffic, render life more easy and comfortable and enable the poorer classes more easily and pleasantly to reach that happy land where houses cease and fields, trees and flowers begin. It will mean better health and cheaper rents and will be a potent factor in improving the lives of a large class of London's inhabitants. It will ease the lives of the middle classes and render the lives of the poor more bearable. Private enterprise needs all the encouragement it can get. It has had none too much of late. Let us remember that it is the great motive power in a country's commercial and industrial life, the motive power that drives the car of progress along the road of prosperity."

GERMAN WIRELESS TELEPHONY.—As to the recent wireless telephone experiments in Germany, a special dispatch from Berlin of January 5 says: "Experiments were first carried out between two buildings in Berlin, separated from one another by a distance of about three miles. The words telephoned through the air without the aid of wires were distinctly heard and taken down at the other end. Experiments were then carried out over the longer distance of twenty-five miles between Berlin and Nauen. The transmitting apparatus, which is similar to that used for sending wireless telegraph messages, was erected on the roof of a building 70 ft. above ground. The receiving station at Nauen was on a high tower used for wireless telegraph purposes. Several conversations were carried on between Berlin and Nauen with perfect success. The words spoken into the transmitter in Berlin were repeated loudly and distinctly by the receiver at Nauen. A distinguished company of invited guests, including the Under Secretary of Posts and Telegraphs, Herr Sydow; several technical advisers to the Ministry of Posts, and a number of electrical engineers, witnessed these astonishing experiments."

CHICAGO ELECTRICAL SHOW.—The second annual Electrical Show opens in Chicago next week, January 14, and runs until January 26. Thirty-three thousand square feet have been taken by exhibitors on the main floor of the Coliseum. The two weeks of the show will be the occasion of numerous electrical gatherings. The Northwestern Electrical Association has its convention at the hall in the Coliseum Annex January 16, 17 and 18. On the evening of January 17 a joint meeting of the Chicago Section of the Illuminating Engineering Society and the Northwestern Electrical Association will be held. At this meeting a permanent organization of the Chicago branch of the society will be effected, as the Chicago branch has heretofore been working with a temporary organization pending the drafting of the new constitution of the Society. The subject discussed at the meeting will be "Street Lighting," taking up the question of large versus small units in street lighting, reflectors for street lamps, and new street illuminants. The Sons of Jove will have a rejuvenation Wednesday night, January 16. The Electrical Salesmen's Association convention is booked for January 24. Ellery's Royal Italian Band has been engaged for the afternoon and evening concerts throughout the two weeks of the show. The Coliseum Annex will be converted into an electrical midway, several new and interesting amusement features along the electrical lines having been secured.

NEW JERSEY TROLLEYS.—An advance went into effect January 1 in the scale of wages of motormen and conductors employed on the northern and central trolley systems, controlled by the Public Service Corporation. The new schedule will affect about 3,000 men. Mr. Albert H. Stanley, for three years general manager of the northern and central systems, has taken charge of the operation of all the company's trolley lines in New Jersey, one of the largest systems in the world.

ELECTRIC ROADS FOR JAPAN.—United States Consul C. B. Harris, of Nagasaki, reports that the early construction of three electric tramways in the northern portion of the Japanese island of Kyushu is under contemplation. The first is to be built from Moji to Kokura, a distance of 8 miles, estimated cost $350,000; the second, from Moji to Yawata, 12 miles in length, at a cost of $500,000, and the third, one of 23 miles, between the important towns of Fukuoka and Kokura, at an estimated cost of $1,250,000 gold.

NEW YORK STATE COMMISSIONS.—Governor Hughes, of New York State, in his inaugural message proposes the abolition of the State Railroad and Gas and Electricity Commissions, and the creation of a new board with the power of both and with additional power to initiate improvements and inflict penalties for disobedience of its orders. He also proposes the abolition of the New York City Rapid Transit Commission and the creation of a new State Board with additional powers for starting improvements in New York service and to have the regulation of local gas and electric corporations.

NEW ENGLAND TELEPHONY.—Mayor Fitzgerald, of Boston, has filed his veto of an order passed by the Board of Aldermen giving a franchise to the Metropolitan Home Telephone Company. The franchise permitted the company to extend its wires through all streets in the city, with the provision that the company should give the city free service. The veto is based on the ground of irregularity in the matter of hearings and advertising, and on the failure to file maps and plans showing the exact location of poles and wires, and also on the ground that it is against the public policy to grant such public franchise without some compensating feature.

ELECTRICITY IN SERVIA.—Mr. M. K. Moorhead, U. S. Consul at Belgrade, Servia, says: "Belgrade and many of the smaller towns are lighted by electricity. As in most other things, the chief source of supply is Austria-Hungary. That the United States can compete successfully in this market is shown by the following example: A few weeks ago I took a trip into the interior of Servia to the city of Valjevo, situated 100 miles from the nearest railroad. There I discovered an electric plant fitted out with American machinery. The owner of the plant told me that American electrical goods gave entire satisfaction and were much better than German or Austrian apparatus."

OWNERSHIP IN EASTON.—Advices from Easton, Pa., of December 26 say: "Disgusted with the continued poor service given by the municipal street lighting plant, sixty of the leading men and business firms of this city to-day petitioned the select council to advertise for bids for lighting the streets, and for bids for running the municipal plant until a private corporation can make arrangements with the city for taking over the service. The municipal service is so poor that women and children are not considered safe on the streets at night, owing to the frequency with which the lamps are out. The municipal plant has been run at a loss of from $4,000 to $5,000 for several years."

ONLY ELECTRICITY CHEAPER.—The Chicago central station companies in the January 1 issues of Chicago dailies presented as an advertisement an interesting set of curves showing the percentage of increase or decrease in the past ten years of various items forming important parts of the cost of living. Rent, food, clothing, servants' wages and anthracite coal all show a decided increase. The cost of electric light service in Chicago shows a decrease of about 45 per cent. The figures on food and clothing are from the United States Government statistics, and the servants' wages figures were obtained from the books of two large employment agencies operating for the last ten years.

PARIS TELEPHONICALLY DEAD.—One of the worst telephone systems in Europe—and that is saying a good deal—is to be found in Paris. The European edition of the New York *Herald* has the following item of news: "M. Simyan, Under Secretary of State of Posts and Telegraphs, has, according to the Paris *Intransigeant*, appointed a commission, at the head of which is M. Troubet, to investigate the workings of the telephone. The members of the commission go to the houses or offices of the subscribers and ring up the exchanges. If too long a time elapses after the call is given until the 'telephoniste' replies a note is made and the matter is investigated. The *Intransigeant* has interviewed a telephoniste, who declares that it is not so much the staff that is at fault as the instruments with which they have to work. In order to make the Paris telephones efficient the whole 'material' will have to be completely overhauled and brought up to date." The "overhaulings" cannot take place any too soon for the credit of Paris.

ITALIAN RAILWAYS.—U. S. Consul J. E. Dunning in a report from Milan on the Italian railway system states that the Mediterranean line, one of the two trunk systems of steam railway in Italy, is seriously at work on the plans for the continuation of the electric road now running from Milan north to Varese and Porto Ceresio, about 50 miles, to Laveno, on Lake Maggiore, via Ponte Tresa, on the Lake of Lugano. At Laveno this extension, which will be operated with the same high-speed express electric service now in use between Milan and Varese and Porto Ceresio, will connect with the existing steam branch to points north, including Luino and Bellinzona on the St. Gothard main line; while at Ponte Tresa another line, now projected, will start direct for Lugano, to connect there with the main line over the St. Gothard pass. If the plan goes according to present indications, the new line—Milan, Varese, Ponte Tresa-Lugano—will be in operation by the end of 1908, thus affording another direct route to Lugano and tapping the richest industrial section of Lombardy.

TELEPHONES AS PROTECTION.—The efficiency of the telephone as a means of protection and insurance is not yet appreciated by any means. The New York public schools are a good example of this. Emergencies constantly arise with the growth of the city and the building of school houses for two or three thousand pupils each, in which it is necessary to communicate quickly with the outside world. In the foreign quarters of the city strange rumors are circulated and almost within the twinkling of an eye there appear at the doors of the building an angry mob of crazy mothers demanding what the authorities mean by cutting the throats of children or lacerating their arms with knives. "Disturbances like this may spread through a whole district," said a well-known principal the other day, "without the teaching force in the schools being aware of it until it is threatened with riot and panic. The few schools in which district superintendents have their offices have telephones. In one of the riots of parents recently I learned that there was trouble in the neighborhood and went to the office of the district superintendent in the building and used the telephone. Police headquarters informed me that the trouble extended all over the East Side, that there were no more reserves and that the best thing I could do was to dismiss my school without delay. Had it not been for the telephone I should probably have been unable to cope with the situation. There is a fire alarm system in the schools, to be sure, but the telephone is surer, for where there are so many children there is no telling what might befall the mechanism." Principals throughout the city think that schools in the most crowded districts at least should be in touch with the city by wire.

ENGLISH PATENT SYSTEM.—A special cable dispatch from London of December 29 says: "The *Tribune* announces that the long-promised amendment of our patent laws will be introduced next session by Mr. Lloyd George, the president of the Board of Trade. The chief provision will be an enactment for the compulsory working in this country of patents held by foreign firms. The costs of the compulsory license under this provision will be reduced to the standard prevailing in Germany."

COAL VERSUS WATER POWER.—A coal mining company in the southeast of France has found that the use of electricity generated by water power has so greatly reduced its market for coal that it has decided upon generating electricity at the mouth of its mines for distribution and sale. The directors have voted an issue of $600,000 in bonds to defray the cost of the electrical generating plant. An arrangement has been made whereby the coal mine plant will not enter into direct competition with the water power plants.

ENGLISH CONDITIONS.—A special dispatch to the New York *Sun* from London reviewing the year says: "In regard to domestic politics nobody in England seems satisfied with the record of the old year or the prospects of the new. A significant change in public sentiment is the rising tide of revolt against municipal extravagance throughout the country, especially in the direction of unsuccessful experiments at municipal trading. The enormous increases in local taxation and municipal indebtedness have excited genuine alarm, and the new year will witness a sharp reaction in England."

A. I. E. E.—An admirable booklet has been issued by the American Institute of Electrical Engineers furnishing information as to the objects, scope and work of that society. It is dated December 1, when it had a total membership of 4,190, of whom two were honorary; 526 were full members and 3,662 were associates. Of these New York claimed more than 25 per cent, namely 1,271; Pennsylvania, 408; Massachusetts, 295; Illinois, 248; Ohio, 195; California, 142; New Jersey, 131, and Missouri, 90. There were 574 members outside the United States, including 142 in Great Britain and 129 in Canada. Including the present incumbent, the Institute has had 19 presidents, since 1884, when it was founded, all but two of whom are living, a curious indication in itself of the youthfulness of the membership as a whole. Out of 61 vice-presidents, all but five are still in harness.

TELEPHONY IN NEW YORK has had a wonderful growth in the last ten years. In 1894 there were only about 10,000 telephone subscribers in the old City of New York. During 1906 the net gain in the entire territory of the two companies, which, generally speaking, embraces a radius of 35 miles from the City Hall, was 67,000 telephones—nearly 200 a day. The result is that the operating Bell companies closed the year with a total of 389,000 telephones in service or under contract, 182 central offices and 17,600 employes. The average of service to population is one telephone to every 14 people. In New York City during the year six new exchanges have been established—Rector, Tremont, Worth, Beekman, Stuyvesant and Audubon. The first two exchanges are now installed in new offices. New quarters for the four last exchanges are nearing completion, and will be ready for occupancy shortly after the first of the year. It is expected that 1907 will see the rate of growth maintained.

EXPORTS OF MANUFACTURES.—Exports of manufactures from the United States in the year just ended aggregated more than 700 million dollars. The Bureau of Statistics of the Department of Commerce and Labor has completed the figures for the eleven months ending with November, and adding to these a conservative estimate for December finds that the total exports of manufactures for the full year will, beyond question, exceed 700 million dollars. Ten years ago, in the fiscal year 1896, they amounted to but 258 millions; in 1886, but 145 millions, and in 1876, 105 millions. The share which manufactures formed of the total exports was, in 1906, 42 per cent; in 1896, but 30 per cent; in 1886, but 22 per cent, and in 1876, 20 per cent. Thus the exports of manufactures in 1906 are three and one-half times as great as a decade ago, and the share which manufactures form of the total exports about one-third greater than at that time. This is the first time that exports of manufactures have crossed or even approximated the 700 million dollar line.

CABLE TO PORTO RICO.—It is stated from Washington that President James A. Scrymser, of the Central and American Telegraph Company, has made application to the War Department for permission to land a cable at San Juan, Porto Rico, and also at Colon, on the Isthmus. It is the desire to lay a cable from New York to Porto Rico and then connect from Colon with a telegraph line across the isthmus to Panama to meet its cable on the Pacific side. Secretary Taft has taken the proposition under consideration. The War Department wishes to have an all-American line of cable connecting Cuba, Porto Rico and the isthmus with the mainland of the United States. In case of war such a line would be of importance held under control by the Government. At the last session of Congress a bill was introduced and passed the Senate providing for a military cable covering practically the same territory, but with a connection at the naval station at Guantanamo, Cuba. This bill, however, which involved the expenditure of about $2,000,000, was lost in the House.

EXPOSITION OF SAFETY DEVICES.—Space is now being assigned for the exhibits of the first International Exposition of Safety Devices, to be held at the American Museum of Natural History, beginning January 29, 1907, and continuing two weeks. The exhibits will include safety devices for wood and metal-working machinery; stamping, grinding and polishing machines; safeguards for boilers, elevators, windlasses, cranes and hoisting machinery; textile and building trades; safety lamps and explosives; quarrying and agriculture; chemical industries, safety from fire, railway and trolley safety. It is earnestly desired that all those wishing to exhibit safety devices in any of the above classes should apply at once to W. H. Tolman, director, 287 Fourth Avenue, New York. The object of this exposition is to awaken the public to the necessity of doing something to lessen the causes of accidents to life and labor by means of a permanent museum of safety devices where all problems of safeguarding life and limb can be studied in their working details. There will be no charge for space.

NO NEED TO GROW OLD.—A cable dispatch from Paris, of December 29 prattles in this pretty fashion: "Provided this electrical cleansing is followed by auxiliary treatment in expelling from our bodies the morbid waste caused by electricity, there is no longer any internal reason for growing old or even dying." This is the promise held out by the *Matin* after a lengthy explanation of Prof. d'Arsonval's high frequency current electric treatment. The discoverer, who is one of the most eminent members of the Academy of Sciences, says the majority of people die of arterio sclerosis. He uses a sphygmometer to measure the tension of the blood in the arteries. If the mercury of the instrument marks fifteen or sixteen centimetres it shows a normal tension. If the tension is higher or lower Prof. d'Arsonval states that six baths of the high frequency current will bring it to the normal, where it will remain, all danger of arterio sclerosis being removed. These baths of five to ten minutes each may be taken three times a week. They give the patient absolutely no sensation. It only remains to find a method of checkmating microbes from without, and the *Matin* believes the world will possess the means of perpetual health.

Applications of Electricity in the Belmont and Pennsylvania Tunnels.

ELECTRICITY has been extensively applied in the various tunnels now building in and around New York City, and in two in particular has it played a great part in the rapid execution of the work to be performed—the New York & Long Island Railroad tunnel, better known as the Belmont tunnel, connecting New York and Long Island City, and the Pennsylvania tunnel crossing New York City. The former is a submarine tunnel passing under Forty-second Street and the East River to Jackson Avenue and Fourth Street, Long Island City. When completed there will be two parallel tubes each accommodating one standard-gauge track fitted with a third rail for use in shuttling electrically-driven trains between the above-mentioned points, the Manhattan terminal being at Park Avenue and Forty-second Street.

BELMONT TUNNEL.

For the purpose of constructing the Belmont tunnel the Degnon Contracting Company has in active operation four shafts and an open cut located as follows: Shaft No. 1, on Forty-second Street, near Third Avenue; shaft No. 2, on Forty-second

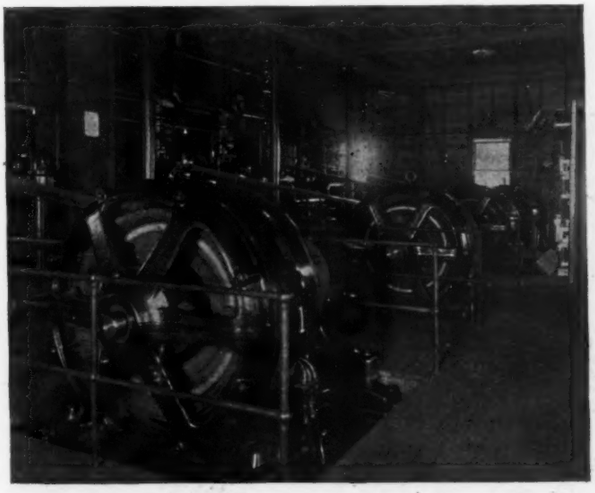


FIG. 1.—MOTOR-DRIVEN AIR COMPRESSORS ON MAN-OF-WAR REEF.

Street and the East River; shaft No. 3, on Man-of-War reef in the East River; shaft No. 4, on Fourth Street and the river front, Long Island City, and the open cut forms the approach to the tunnel in Long Island City. From each shaft are driven four headings, making sixteen headings in all, and the two east headings from shaft No. 4 meet the open cut. Shaft No. 3 on Man-of-War reef consists of two separately-driven 11-ft. shafts joining together at tunnel grade line which is 120 ft. below mean high water.

The greater part of the electricity is supplied by a 2,200-volt, three-phase, 25-cycle line tapped to the feeders of the Interborough Rapid Transit Company. At shaft No. 1 the electricity is supplied from the lighting circuit of the Third Avenue elevated railroad structure and at the shaft is passed through incoming parallel disconnecting switches to a high-tension bus. The motor circuit is taken from a bank of three 440-volt transformers, the lighting circuit being taken from one phase of the high-tension line and transformed to a potential of 120 volts. An effort is made to balance the lighting load per phase with outlying stations of the elevated railroad. Some electricity for driving a blower fan is supplied at this shaft by the New York Edison Company.

The service in shafts Nos. 2 and 3 is supplied from two banks of three transformers wound for a primary voltage of 1,100 and a secondary voltage of 2,200, and located at the Interborough sub-station No. 6 on Thirty-fourth Street. These transformers are on a tie in the service connecting the Fifty-ninth Street and the Seventy-first Street Interborough Rapid Transit power houses. From sub-station No. 6 two three-phase, 2,200-volt cables are carried on the Thirty-fourth Street elevated railroad structure to the river front and from there in submarine cables

FIG. 2.—SWITCHBOARD AND TRANSFORMERS ON MAN-OF-WAR REEF.

to Man-of-War reef. Here tie-in switches connect the cables with a submarine cable running under the river to shaft No. 2 on the Manhattan shore. Originally there were two cables alotted to shaft No. 2. One is given over for 11,000-volt service carried to the Interborough sub-station in Long Island City. The cable is joined with another submarine cable from Long Island City on Man-of-War reef.

At shaft No. 2 the 2,200-volt current is transformed to 440 volts for motors and 120 volts for lighting circuits. The equipment consists of two hydraulic pumps belt driven from two 40-hp, three-phase, 440-volt motors. These motors are accel-

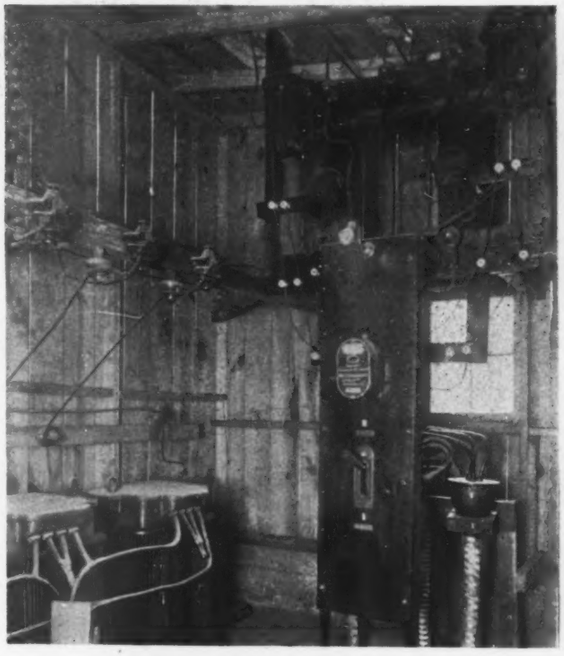


FIG. 3.—INTERIOR OF SWITCH HOUSE, SHAFT NO. 2.

erated through automatic control boards which operate with the rise and fall of an hydraulic accumulator acting on an electric float switch. The switch both starts and stops the motor at the proper time to take care of water used from the pumps. The pumps are employed for working the hydraulic jacks which

force the tunnel shields onward. They also furnish water for the erectors that follow the shields. The latter are used in placing the cast-iron segments which form the rings for lining the tunnels. There are a number of smaller motors used about this shaft. The motors driving concrete mixers are gear-connected to the mixers which are placed at the bottom of the shaft. This is not the very best place for electric motors, but

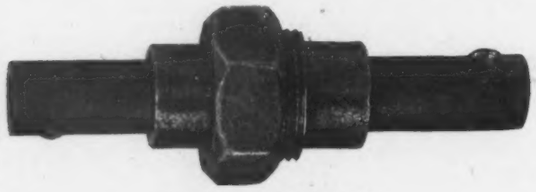


FIG. 4.—WIRE CONNECTOR.

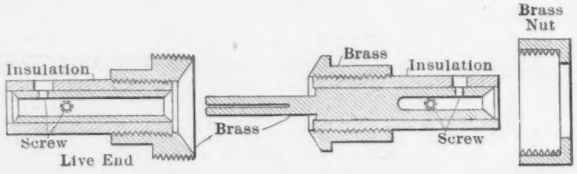


FIG. 6.—CROSS-SECTIONAL ELEVATION OF CONNECTOR.

what with a protection from the dripping water and what with the continual burning of electric lamps in the motor house, dampness is kept away and operation goes on uninterrupted.

The equipment on Man-of-War reef in the East River consists of four 200-hp, 2,200-volt, three-phase, constant-speed motors belted to air compressors. The motors are brought up to speed through auto-transformers and are then cut in on the line by throwing over the oil switch to the running position. Some inconvenience was at first experienced in keeping up the speed of the motor to permit its being thrown on the line because the pressure against which the compressors work make it hard to start an induction motor under load. The compressors are provided with a device for throttling the inlet air and it is possible by opening the inlet valve of the device to let the motor come up to speed and to be thrown on the line before the pressure produces any back action. In cases where this is not possible or where the compressors are not provided with the inlet valve for control, a check valve is placed in the discharge line ahead of the air receiver and a pipe tapped ahead of the valve allows the first air compressed to escape into the atmosphere. After the motor is in operation the valve on the blow-off pipe is closed and the air passed into the receiver. At this shaft there are also two motors driving hydraulic shield pumps, a machine shop motor and motors used for elevator service and concrete mixers. The elevator motors are variable-speed machines governed by street railway type controllers, and have given excellent service. The lighting circuit on the reef is taken from one phase of the 2,200-volt bus and stepped down to 120 volts. At shaft No. 2 two of the three phases are used through separate transformers for lighting purposes. At shaft No. 3 the third phase is picked up for lighting, and by this means an effort made to balance the load across the phases.

The outfit at shaft No. 4 consists of two steam-driven generators operating in parallel. These units are used to furnish the energy for lighting only. The sawmill at this point is driven by a two-phase motor supplied from the lines of the New York & Queens Electric Light & Power Company. The open cut is lighted by purchased electricity, the generator originally installed for this purpose having been dismantled.

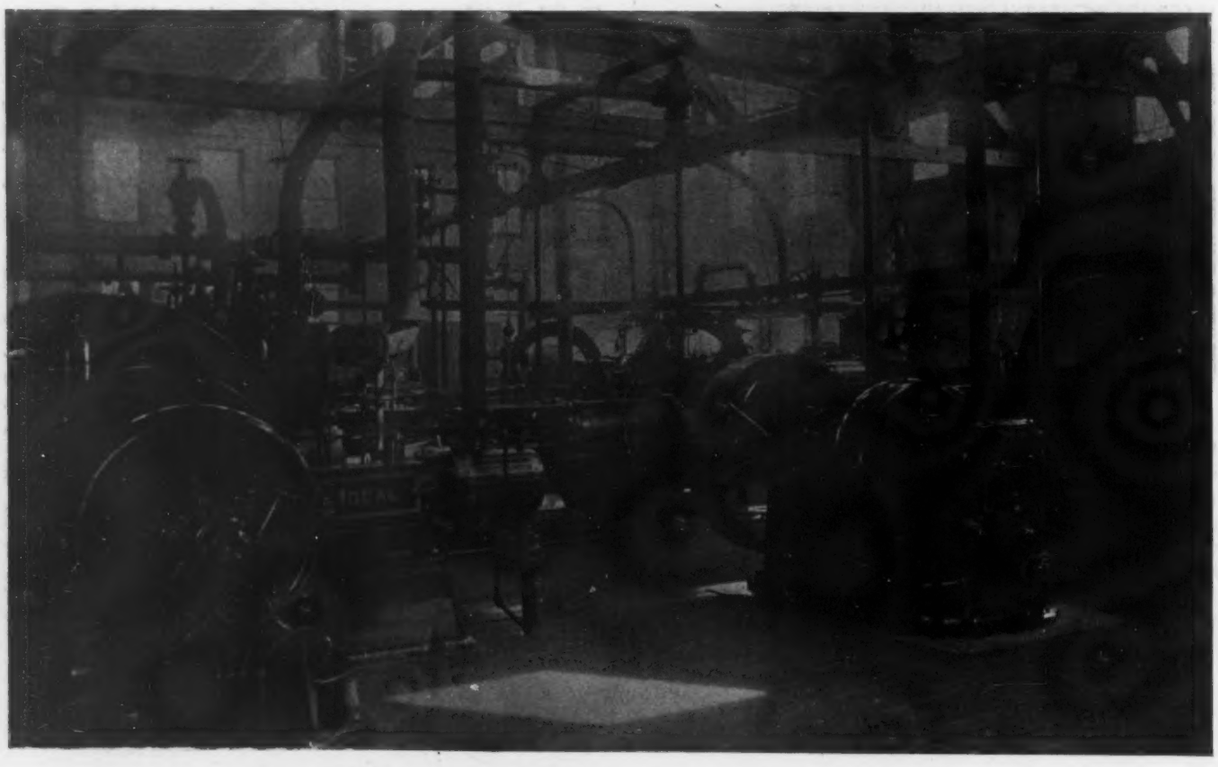


FIG. 5.—POWER PLANT AT SHAFT NO. 4, LONG ISLAND CITY.

Incandescent lamps are used exclusively for lighting since they offer marked advantages over other forms of electric lamps, being easier to maintain and less liable to breakage. Many difficulties arise in lighting tunnels of this kind, since the worst conditions are met with. There is a constant dripping of salt water and an ever-present fog. Where the tunnel is dug under pressure this fog penetrates the insulation, the air pressure tending to force the moisture collecting everywhere

into the minutest opening, the pressure being over three atmospheres. Water-proof glue or cement must be used to keep the lamp bulbs tight in the base. The lamps are slipped through round soft-rubber rings fitted to them close up to the socket so as to keep moisture out of the sockets. Hard rubber sockets are best for this service, particularly on account of breakage. There is so much changing of the position of the lamps that breakage is quite a question with which to contend. The lamps are enclosed in strong guards made specially for the purpose. The upper part of the guard is short to allow of better protection to the lamp; the lower part is fastened to the upper by a round turn of the hinge wire, thus keeping the parts together as the guard is violently and frequently opened. Before the adoption of this form of guard the lower half would usually drop off when opened a number of times and be lost. In submarine tunnel work the old T.-H. base is much better than the Edison base, since in the former neither contact is exposed to moisture as in the latter. When a blast is to be fired it is necessary to break the connections in the lighting circuits so that the lines and lamps may be carried back out of the way. This must be done quickly so as not to delay the work and must be as quickly made again after the blast has been fired. This making and breaking of connections takes place very often in one day and in order to allow this to be readily done a Paul connector is employed. This connector was made especially for this work and allows of a water-tight joint and one that can be quickly made and broken with the bare hands. The connectors are made single pole and are placed one ahead of the other so as to eliminate any deteriorating effect, accidental ground or short-circuit.

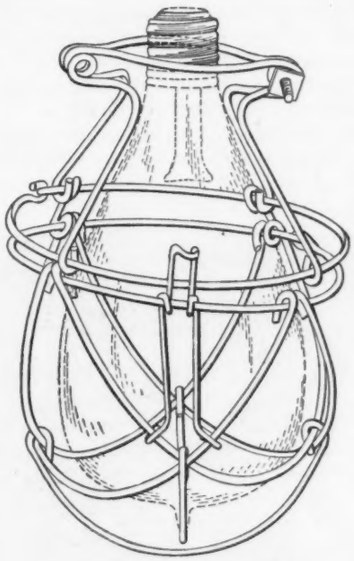


FIG. 7.—LAMP GUARD.

The connector is shown in section herewith. It consists of a ground joint brass union having a fibre tubing screwed into the threaded ends. Through a hole in the fibre is forced a brass rod. The female side of the union has a hole drilled through the brass rod lengthwise. One end of this hole, that away from the union, receives the wire which is fastened by set-screws through the fibre and tapped into the rod. The hole in the end next to the union is of a size to receive the split end of the male half of the union. This side is also provided with means for connecting the wire as shown. The electrical connection is made by merely shoving the parts together and the union is tightly held in place by screwing up the collar. The fibre parts are covered with tape and shellacked so as to keep out moisture from the set-screws and wire end of the union. It should be remembered that what is ordinarily looked upon as weather and water-proof is not so when brought into a submarine tunnel filled with compressed air. Everything is wet and muddy; the wires and lamps are thrown about in the mud and receive anything but gentle treatment, so that special pains are taken in taping and protecting these to make them weather and water-proof and withal fool-proof.

PENNSYLVANIA TUNNEL.

The submarine tunnels of the Pennsylvania, New York & Long Island Railroad will be connected with the great terminal station of the Pennsylvania system by four tracks carried from the East River shafts at First Avenue under Thirty-second and Thirty-third Streets to Seventh Avenue. The work west of First Avenue is being prosecuted from six headings reached by four shafts located in pairs at First Avenue and between Fourth Avenue and Madison Avenue, each pair independent of the other and equipped with a complete power plant. The top of the intermediate shaft at Thirty-third Street is covered by a structure housing the power plant and hoisting apparatus. On the first floor of this structure are two air compressors each direct-connected to a Ft. Wayne motor. Water for the cylinder jackets and intercoolers is circulated by an electrically-driven centrifugal pump which delivers the warm water to a cooling tower above the power house roof. The power house contains besides the motor-driven compressors a switchboard for the compressor service and another which controls the wiring for all purposes in the Thirty-second Street and Thirty-third Street shafts. Electricity is purchased from the New York

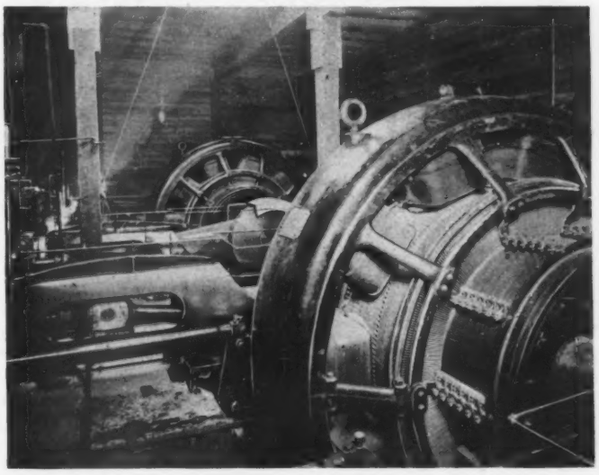


FIG. 8.—MOTOR-DRIVEN AIR COMPRESSORS AT THIRTY-THIRD STREET SHAFT OF PENNSYLVANIA TUNNEL.

FIG. 9.—SWITCHBOARD IN POWER HOUSE, PENNSYLVANIA TUNNEL.

Edison Company and is used chiefly for operating the compressors, for motors above ground, for firing blasts, for lighting and for operating electric locomotives in the tunnels. At the top of the Thirty-third Street shaft is a room containing a pressure blower driven by a 15-hp motor, which forces air to the headings where it is used to blow out the smoke and gases after

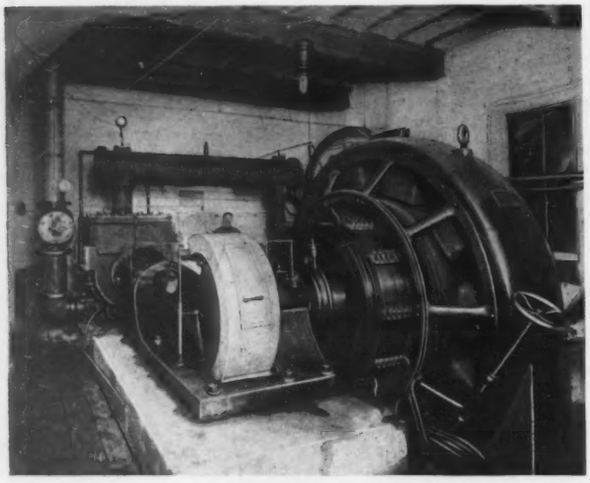


FIG. 10.—MOTOR-DRIVEN COMPRESSOR AT EAST RIVER SHAFT OF PENNSYLVANIA TUNNEL.

blasting. Ordinarily sufficient ventilation is provided by the exhaust from the compressed air apparatus in the tunnel and the blower system is operated only after blasting or when humidity and other weather conditions make it necessary.

The Thirty-third Street shaft is sunk through solid rock to a depth of 96 ft. measured to the bottom of the 10-ft. sump, and has no lining or timbering. All lamp and motor wiring is carried down the shaft in three 2-in. loricated pipes. Two three-foot tracks with double crossovers run from the foot of the shaft to the main tunnel a distance of about 50 ft., where they connect with two main lines of the same gauge extending from heading to heading and provided with numerous switches and crossovers. A third track paralleling these tracks enables a shovel to be removed daily from either heading to the other as required to alternate with the drilling and blasting. The regular tunnel excavation is about 30 ft. wide and 20 ft. high. The

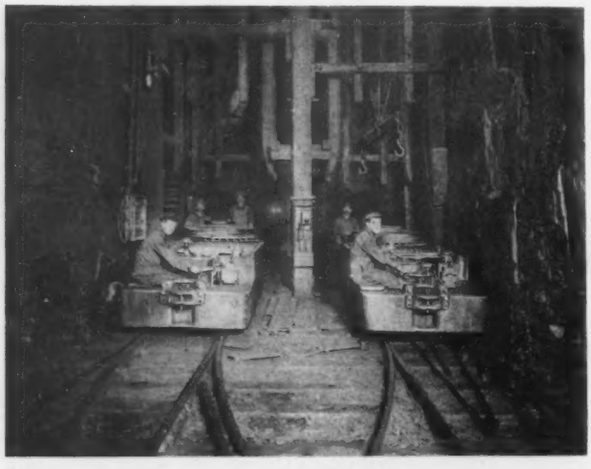


FIG. 11.—ELECTRIC MINE LOCOMOTIVES IN PENNSYLVANIA TUNNEL.

tunnel passes under the subway of the Interborough Rapid Transit Company with a clearance of about 35 ft. The blasts are fired with 120-volt current carried to a point near the heading where a switch is installed with a red lamp continually burning and protected by a timber shield. When the holes are loaded with powder, the men leaving the heading connect successive breaks in the circuit and when all is ready the current is turned on at the red lamp switch and the charges fired. Returning the switch is opened and the circuit is broken at successive points in the reverse order.

The shovel is run close to the bench and loads all of the rock, etc., into special steel skips delivered there by flat cars drawn by mine locomotives of General Electric make. On account of the difficulty of maintaining the trolley wire close to the heading where they would be liable to injury from the blasts, the locomotives are run to a point 50 ft. back of the bench where they deliver the cars in trains of four or six to a siding. From this siding the cars are jacked in to the shovel as required by a mule or pushed by hand according to the grade. When the car is filled it descends by gravity to the end of the trolley line or the electric locomotive runs down by means of the reel and hauls it back in trains of four cars to the shaft. A second locomotive draws the cars from the other headings to the transverse tunnel leading to the shaft. Two cars are taken from this point to the foot of the shaft by their locomotives and the other two are hauled to the shaft by a hoisting engine.

The tunnel is wired on the three-wire system and in order to operate the locomotives directly from this system the latter are equipped with a double trolley making contact with both outside wires. Close to the headings and near the shafts the

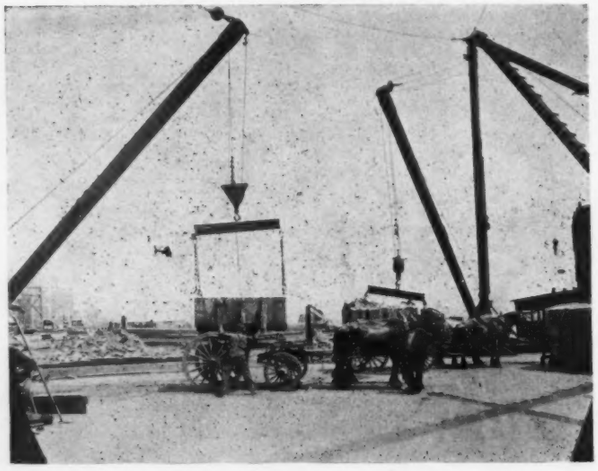


FIG. 12.—ELECTRIC CRANES UNLOADING SKIPS AT PIER.

reel is used in place of the trolley. The tunnel is lighted by incandescent lamps with arc lamps at intervals.

The steel skips in which the muck is handled are of special construction. Owing to the magnitude of the work and a desire to prosecute it with the utmost rapidity and minimum interference with street traffic and to work throughout the twenty-four hours of the day without undue disturbance or noise, it was decided to transfer the material directly from the tunnel cars to wagons in the street for removal, without dumping from the skip to the wagons, or by employing cages and dump cars, the methods commonly employed. Double handling is thus avoided. For this purpose a quick dumping skip is used in connection with a special telpher hoisting and handling system. The telphers are electrically operated and the equipment enables the skips to be loaded in the tunnel working in the usual manner, thence hoisted directly to the surface and delivered direct to wagons for removal in a single operation. The skip consists of a divided rectangular box of steel plate opening longitudinally through the middle, the two halves being hinged at the upper rim at both ends. Although the halves tend to remain closed whether empty or loaded latches are provided at both ends for locking them together when the skip is being hoisted in the shaft to guard against accidental opening in case the skip

should strike the sides of the shaft. The telpher hoists are designed for lifts of 125 feet to enable them to lift directly from the tunnel level, and have a single-drum hoist driven by a 75-hp G. E. series railway motor capable of raising the maximum load at the rate of 200 ft. per minute. The telpher is driven by a 15-hp reversible crane motor capable of giving the outfit a traveling speed of 600 ft. per minute. The controllers for both motors are located in the operator's cab. The motors operate from a 220-volt circuit supplied by the New York Edison Company. The Dodge Coal Storage Co., of Philadelphia, furnished the telpher machines.

At the dock at the foot of East 35th Street, the skips are unloaded from the wagons and the contents dumped into scows moored to either side of the pier by two stiff-leg derricks equipped with 40-hp hoists operated by electric motors. The total time required for dumping from the time the skip is lifted from the wagon until it is replaced empty is seldom over 30 seconds. The wagons approach the unloading derricks in regular order and pass on and off the pier in 1¾ minutes including the time of the unloading operation, while in many cases they are released in less than a minute. The time required to take the skip from the bottom of the shaft and deposit on the wagon varies from 30 seconds to a minute, thus showing a large saving of time and labor effected by single handling of material.

In the yard adjacent to the river shafts is located the power plant for the tunnels driven from this point. The power house contains a compressor like that at the Thirty-third Street plant and two smaller compressors. The smallest compressor is operated by a 100-hp motor and as it was difficult to secure a 200-hp motor promptly for the larger compressor two 100-hp motors were provided, both being belted to the same driving wheels, one belt passing inside the other. The repair shop in the yard is equipped with a 5-hp motor. The telpher system at the East River shafts is the same as that already described, differing only in arrangement. The Thirty-second Street shaft and tunnels also correspond substantially with those described except that the shaft house only provides for the telpher system, all power being supplied from the plant on Thirty-third Street. The contractors for the tunnel are the United Engineering & Contracting Company, and the work is being directed by Alfred Noble, chief engineer of the East River division of the Pennsylvania, New York & Long Island Railroad Company. We are indebted to the New York Edison Company for the photographs of the Pennsylvania tunnel and to H. R. Bailey, of the Degnon Contracting Company, for information regarding the Belmont tunnel.

Cost of Mine Haulage by Means of Electric Locomotives.

A recent issue of the *Engineering and Mining Journal* contains an article by Mr. W. F. Murray, showing the advantages to be derived from substituting electric locomotives for mules in mines. The chief advantage of the locomotive is due to the fact that it can haul a much larger load than is possible with mules, and will make better speed. The cost of installing electric haulage is greater than when mules are used; however, when the cost of erecting a stable and the great loss due to mules killed in accidents are considered it is found that even the initial expenditure is not greatly favorable to the use of the mules.

In a certain mine where one locomotive replaced 14 mules, the output remaining as formerly at 367,500 tons per year of 245 working days, the interest on the initial expenditure for the mules and the cost of keeping and using them was $6,577.20 per year, or 1.79 cents per ton mined; as compared with a total of $4,615 per year, or 1.26 cents per ton when the locomotive was used. Thus from the standpoint of operating costs the locomotive is much preferable to the mules. It is stated that the average active life of a mine mule is from seven to ten years, while a good locomotive should last, with occasional repairs, about 25 years.

Simple Formulæ for the Relations Between Deflection, Tension and Temperature in Wire Spans.

By Harold Pender, Ph.D.

THE following closely approximate formulæ give the relations between the changes in deflection and tension in wire spans due to changes of temperature, in terms of the constants of the wire, length of span, wind pressure, weight of ice on the wire, and maximum allowable tension. The results arrived at are not new;* the formulæ given, however, are put in a convenient shape for numerical calculations.

Let α = coefficient of expansion of wire per ° F.
M = modulus of elasticity (pounds—square inches).
A = cross-section of wire in square inches.
m = weight of 1 ft. of wire 1 sq. in. cross-section.
ρ = ratio of the resultant of weight of wire and sleet and the wind pressure to the weight of wire.
T_o = tension at center of span in pounds per square inch at temperature t_o.
T = tension at center of span in pounds per square inch at temperature t.
**D = deflection of wire at center of span in feet in the direction of the resultant force at temperature t.
l = length of span in feet.
L_o = length of wire at temperature t_o under tension T_o.
L = length of wire at temperature t under tension T.

$$K_o = \frac{\rho_o l}{T_o} \qquad K = \frac{\rho l}{T}.$$

As a rule, the maximum tension occurs at minimum temperature; T_o and t_o may, therefore, be taken as maximum tension and minimum temperature, respectively.

For any Wire:

$$t - t_o = \frac{1}{\alpha}\left[\frac{m^2}{24}(K^2 - K_o^2) + \frac{1}{M}(T_o - T)\right] \qquad (1)$$

$$D = \frac{m l K}{8}. \qquad (2)$$

Copper Wire:

$$t - t_o = 6.5\,[10^4\,(K^2 - K_o^2) + 10^{-3}\,(T_o - T)] \qquad (1a)$$

$$D = 0.48\,l\,K. \qquad (2a)$$

Aluminum Wire:

$$t - t_o = 4.4\,[10^5\,(K^2 - K_o^2) + 2 \times 10^{-3}\,(T_o - T)] \qquad (1b)$$

$$D = 0.145\,l\,K. \qquad (2b)$$

These expressions for the increase of temperature corresponding to a given change in tension are comparatively simple. The expression for change in tension or change in deflection, for a given change in temperature, involves the solution of a cubic equation; it is, therefore, simpler, in making numerical calculations, to choose various values for T and plot the corresponding values of t in the form of a curve, from which the value of the tension for the temperature in question can be taken; a simple calculation (formula 2) then gives the deflection.

The proof of these equations follows:

The approximate equations for a wire suspended from two points are:

$$D = \frac{\rho m l^2}{8T} = \frac{m l K}{8} \qquad (3)$$

* See C. T. Hutchinson, *Engineering News*, Vol. 42, p. 130, 1899.

**D is the deflection in the direction of the resultant force; this coincides with the vertical deflection only in case of no wind. The vertical deflection with wind is equal to D multiplied by the ratio of the sum of the weight of wire and ice coating to the resultant of the weight of wire, weight of ice coating and the wind pressure.

$$L = l\left[1 + \frac{8}{3}\left(\frac{D}{l}\right)^2\right] = l\left[1 + \frac{m^2}{24}K^2\right] \quad (4)$$

Similarly,

$$L_o = l\left[1 + \frac{m^2}{24}K_o^2\right] \quad (4a)$$

The relation between length (L) of wire at temperature t under tension T to length (L') at zero temperature and unstressed is given by the equation

$$L = L'\left(1 + \frac{T}{M}\right)(1 + \alpha t). \quad (5)$$

Similarly,

$$L_o = L'\left(1 + \frac{T_o}{M}\right)(1 + \alpha t_o). \quad (5a)$$

Combining the last four equations, there results

$$\alpha(t - t_o) = \frac{\left[1 + \frac{m^2}{24}K^2\right]\left[1 + \frac{T_o}{M}\right] - \left[1 + \frac{m^2}{24}K_o^2\right]\left[1 + \frac{T}{M}\right]}{\left[1 + \frac{m^2}{24}K_o^2\right]\left[1 + \frac{T_o}{M}\right]}$$

The second term of each of the factors in the above expression in any practical case is of the order 10^{-8} or less; hence, the cross products of these terms may be neglected, and the denominator of the fraction may be considered unity. Making these assumptions and simplifying, we get

$$t - t_o = \frac{1}{\alpha}\left[\frac{m^2}{24}(K^2 - K_o^2) + \frac{1}{M}(T_o - T)\right] \quad (6)$$

Values of the Constants:

	Copper.	*Aluminum.*
Coefficient of expansion.....	9.6×10^{-6}	12.8×10^{-6}
Modulus of elasticity.....	16×10^{6}	9×10^{6}
Weight per ft. x sq. in.....	3.85	1.16

The substitution of these values in the general equations (6) and (3) gives the formulæ (*1a*), (*2a*) and (*1b*) and (*2b*).

The Standard Cell.*

By F. A. Wolff and C. E. Waters.

During the past year considerable work has been done at the Bureau of Standards to obtain data to serve as the basis of specifications for the construction of both Weston and Clark standard cells. While much still remains to be done, considerable experimental material has been gathered on the accuracy with which it is possible to reproduce these standards. The results of this work are submitted in abstract; full details will, however, be given shortly in the *Bulletin* of the Bureau of Standards.

Efforts were first directed to the preparation of mercurous sulphate of uniform electromotive properties for which the following methods were employed:

1. The electrolytic method, developed in 1904 by one of the authors and also independently by Carhart and Hulett. In this method the mercurous sulphate is formed at a mercury anode in sulphuric acid. Thirty-eight samples were prepared with current densities ranging from less than 0.1 to more than 9 amp. per sq. dm., while the concentration of the sulphuric acid varied from 20 to 400 grams per liter.

The samples were made between 1904 and 1906 and two different forms of apparatus were employed.

2. By the recrystallization of "c.p." samples purchased from various manufacturers, from strong sulphuric acid.

3. By the action of fuming sulphuric acid on mercury.

4. By the action of sulphuric acid on mercurous nitrate.

5. By the reduction of mercuric sulphate by mercury.

6. By the reduction of mercuric sulphate by sulphurous acid.

7. By the direct action of sulphuric acid, containing a small percentage of nitric acid, on mercury (Lunge reaction).

8 and 9. Two electrolytic samples obtained from Dr. Hulett.

10. By digestion of "c.p." samples with hot 1:4 sulphuric acid.

11. By digesting "c.p." samples with 1:4 sulphuric acid since 1904.

12. Same as 11—other samples.

13. By digesting "c.p." samples with 1:6 sulphuric acid since October, 1905.

The electromotive properties were tested by setting up at least one Clark and one Weston cell for each sample.

The remaining ingredients were carefully purified, and when different samples of the same material were employed, check cells were always set up to test for any variation which might thus be produced.

Between three and four hundred cells have already been set up. They are all of the H type, hermetically sealed and are compared under oil in specially constructed electrically-controlled baths in which the temperature may be kept constant well within .01° C.

Cells of the same type were compared at frequent intervals by measuring the e.m.f. of each cell in opposition to one selected as a comparison standard, so that the results could readily be expressed in terms of it or any combination of cells measured. The values obtained from day to day generally agree to within a few parts per million, and although most of the Weston cells of the bureau are seven months old no tendency for a decrease in e.m.f. as observed by Hulett has been found. A small number of cells which showed high initial values have decreased, but not below the mean of all the cells made with electrolytic mercurous sulphate. The same remark applies to samples made by the various chemical methods employed.

In addition the ratio of Clarks to cadmiums was determined from time to time, but the small differences observed amounting to from two to three parts in 100,000, and which include errors of temperature measurement and those due to defective insulation of the cells in the bath and between the individual coils of the high-resistance potentiometer employed, indicate an apparent decrease of the Clarks or an increase of the Westons.

A considerable number of Weston cells recently set up have somewhat smaller values of e.m.f. than those first set up, but the difference does not exceed 10 microvolts. The table below gives the results for all the cells set up for studying the influence of mercurous sulphate. The differences are expressed in microvolts and the mean e.m.f. of all the cells made with electrolytic sulphate is taken as a standard of reference.

	Weston Cells				Clark Cells		
Method.	No. of samples.	No. of cells.	Range. Microvolts.	Mean. Microvolts.	No. of cells.	Range. Microvolts.	Mean. Microvolts.
1	38	50*	±20	00	51**	±20	00
2	5	5	+ 1 —26	—12	5	+ 4 —22	— 9
3	1	1	— 4	— 4	1	— 2	— 2
4	2	5	— 7 —21	—16	2	0	0
5	2	2	—10 —12	—11	2	0 — 9	— 4
6	2	3	+38 —19	+ 4	2	+ 5 + 5	+ 5
7	6	9	— 5 —23	—14	10	— 2 —14	—11
8	1	2	+34 +27	+30	3	+44 +23	+33
9	1	3	+ 3 — 5	— 1	3	+ 8 + 6	+ 7
10	6	6	+23 —17	+ 4	8	+44 — 1	+18
11	5	5	+55 + 1	+27	5	+67 +12	+37
12	4	4	+80 +22	+50	—	—	—
13	6	6	+117 +21	+70	8	+143 +60	+90

*5 additional cells were set up.
Values, +43, +35, +23, —21, —27,. Duplicates of 4 of these fall within the limits ±20.
The average deviation of the electrolytic cells from the mean of all the electrolytics is ±11 microvolts.

**6 additional cells were set up.
Values, +36, +23, +22, —22, +33, +24.
Duplicates of 4 fall within limits ±20.
The average deviation of the electrolytic cells from the mean of all the electrolytics is ±10 microvolts.

* Abstract of paper read at the New York meeting of the Am. Phys. Soc., Dec., 1906.

Clark and Weston cells have been exchanged with Prof. Hulett and very recently with Prof. Carhart and Prof. Guthe. In addition four electrolytic Weston cells made at Cornell University by Mr. Wold have been compared at the bureau. The results of these comparisons are given below in terms of the means of the bureau cells.

	Weston Cells		Clark Cells	
	Cell.	Mean Difference in Microvolts.	Cell.	Mean Difference in Microvolts.
Prof. Hulett	A_8	+45	H_4	−15
" "	A_{32}	+27	H_{18}	+ 5
" "	O_4	40		
Prof. Carhart	No. 5	+ 1	C_2	00
" "	No. 8	+ 4		
Prof. Guthe	Cl	+25	Al	+65*
Mr. Wold	No. 24	− 9		
" "	No. 27	−10		
" "	No. 20	−24		
" "	No. 21	−15		

* Approaching normal value.

While the direct comparison of cells made by Prof. Hulett with those made at the bureau shows a discrepancy of from 25 to 45 microvolts, cells made by the authors with sample No. 9 of mercurous sulphate shows that the differences are probably not due to a difference between the mercurous sulphate used, but rather to some difference in the other materials or to some difference in the specifications employed.

Samples of the various materials will, therefore, be exchanged to determine the cause of difference with other investigators in this field, and it is confidently expected that as excellent agreement can be reached by all when the same specifications are followed, as is here shown.

A study has also been made on the electromotive differences of cadmium sulphate obtained from various makers or made directly from the "c.p." metal. Twenty cells set up with clear and cloudy crystals, obtained by the recrystallization of 8 samples, from acid, neutral and basic solutions show an average deviation from the mean of all of ± 9 microvolts and with a range of $+28$ and -26.

Further work is in progress on the remaining materials and on other factors which might influence the e.m.f.; that is, the size of grain, depth of paste, influence of diffusion, influence of added impurities and a careful determination of the temperature coefficients will be made.

The main conclusions to be drawn are that, since samples of mercurous sulphate of uniform electromotive properties can be made by a number of different methods, and, since the remaining materials used in the construction of standard cells can be obtained in an exceedingly pure state, Clark and Weston standard cells are reproducible to within two or three parts in 100,000, that when set up with proper materials they reach a permanent value of e.m.f. within a few days, and the e.m.f. of the Weston cell can be depended on as constant well within the above limits for at least six months.

Another conclusion that might be drawn is that the standard cell has a marked superiority, both in ease and accuracy of reproduction over the silver coulombmeter as a fundamental electrical standard, particularly as the results obtainable with the latter can be preserved only by the aid of a standard current balance, or the combination of a standard resistance and a standard cell, both of which must be assumed constant between silver coulombmeter measurements.

With materials at hand, and if necessary these could be procured by investigators from the various Natural Physical Laboratories, a number of cells can very readily be set up in far less time than that required for a coulombmeter measurement, and with a greater certainty of reproducing the volt than is possible by the coulombmeter and standard resistance, both of which are subject to error.

Moreover, the choice of the standard cell and the standard resistance as fundamental standard is the most logical as practically all voltage and current measurements of precision are made by the potentiometer method, and thus directly in terms of the standard cell or the combination of a standard cell and a standard resistance.

Sustained Electrical Oscillations.

An interesting application of mercury vapor converters to wireless telegraphy is disclosed in two patents recently issued to Mr. Frederick K. Vreeland. In order to be able to feed energy into the circuit constantly or at intervals in synchronism with the oscillations so as to supply that lost in radiation and otherwise, the inventor employs the effect of a magnetic field upon sensitive gaps formed by current passing through a mercury vapor tube. In the accompanying diagram, which illustrates one of the arrangements proposed, the mercury vapor tube has two anodes and a single mercury cathode, a source of direct current being connected from the cathode to the anodes by two branches containing a condenser, and two deflecting field coils are shunted across the anodes. For simplicity of illustration the field coils are shown with their axes in the plane of the anodes, while in practice they are placed in a plane perpendicular to that in which the anodes are located, so that the magnetic flux will be perpendicular to the plane of the anodes.

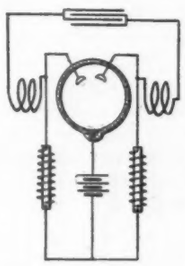
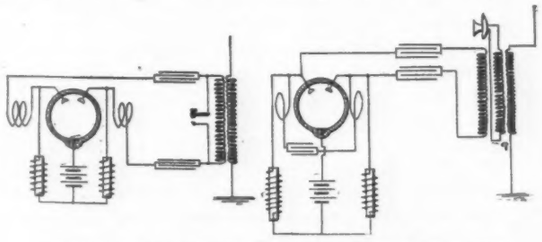


FIG. 1.—APPARATUS FOR PRODUCING SUSTAINED OSCILLATIONS.

When the apparatus is started the current tends to divide equally between the two parallel paths, but there is always some variation in the distribution due to variable inequalities in the conductivities of the two paths. This is especially true when a mercury vapor tube is used. These irregular fluctuations are sufficient to start the oscillations, after which they give place to the periodic fluctuations controlled by the alternating field. When the magnetic field deflects the current in the tube, from one anode to the other, the tendency is for the current in both branches to pass wholly or largely through the tube from the latter anode to the cathode, due to the fact that the path through the tube from the former anode to the cathode is interrupted or increased in resistance by the deflection of the current toward the other anode. As the inductances oppose any change in the current passing through them, this results in the current in the branch flowing through the oscillating circuit from left to right, including both field coils, thereby producing a field which still further deflects the current from one anode to the other. When the condenser is charged to the requisite potential, this current is checked and reversed, thereby producing a field in the opposite direction which deflects the current in the tube, so that the idle anode becomes active. In this way energy is supplied to the oscillating circuit in synchronism with the oscillations. The frequency of these oscillations is dependent upon the constants of the oscillating circuit and may be changed by changing such constants.



FIGS. 2 AND 3.—APPARATUS FOR UTILIZING SUSTAINED OSCILLATIONS.

Sustained oscillations are desirable especially in wireless telegraphy or telephony. A simple arrangement for wireless telegraphy is shown in Fig. 2. The oscillating circuit includes the primary of a step-up transformer, whose secondary is connected in series with the antenna circuit, which is suitably tuned with respect to the primary circuit. The radiation is made intermittent at will for the purpose of producing signals by means of a key which short-circuits the primary of the step-up trans-

former, and thus annuls its action on the antenna circuit. For wireless telephony use is made of the arrangement shown in Fig. 3, in which the working oscillating circuit is separate from the oscillating circuit which excites the field. The inductance is utilized as the primary of a step-up transformer, whose secondary is in the antenna circuit. The tertiary of the transformer is closed by a carbon telephone transmitter having a sufficient current-carrying capacity to answer the purpose.

Refrigeration and Power Production.

THE fact that mechanical refrigeration is sometimes produced in large power plants as a by-product resulting from certain limitations in the utilization of the power is well known to most engineers. The extent to which this process is an efficient one and the possibilities of its further extension are not as commonly known. In fact the reasons by which mechanical refrigeration becomes practical and desirable under these circumstances and the extent to which these reasons operate are still more unfamiliar. The problem of power production is generally treated by engineers familiar with this work only and the limitations of refrigeration and its possible future development with the resulting influence on this work is practically unknown.

That refrigeration is an extremely convenient and efficient method of utilizing power that would otherwise go to waste is true, but the extent to which this movement is likely to continue and its limitations are absolutely unknown. Now in power production in very many cases the power is utilized in the trolley and lighting service and under these circumstances the load on the plant is extremely variable with a large peak in the morning and afternoon. While in some few cases storage batteries are installed for charging at times of light line load, these are exceptional and to-day steam units are installed sufficient to take care of the peak of the load permanently, which means that during the remainder of the time the engines are working at a less than maximum efficiency or a large amount of power is being wasted. The utilization of this excess power has been attempted in a number of ways. Special rates were offered to consumers of this intermittent power with the proviso that their consumption should be intermittent. Often this condition was absent, however, and the contract was made on the assumption that the load whatever it was could be taken care of somehow. As a result the number of small power consumers using electricity in this field has rapidly increased. Mechanical refrigeration has been rendered practical and efficient in a number of small refrigerator plants by this development, and the development of the compression machine in refrigeration on this account has been much extended. Refrigeration in these small units presents a very favorable aspect to this development. They are capable of utilizing power at intervals and storing sufficient refrigeration in their pipes at this time to tide them over the inactive period. Thus the small power consumer in refrigeration holds a most advantageous position in regard to power consumption and the development of excess power in some plants.

This represents the development to the extent to which it has progressed in many power plants. Still others have installed a refrigerating plant to run in conjunction with the power plant and utilize excess power when available, and thus they operate in addition an ice factory or cold storage plant, which has often proved very profitable. The ability to tide over long periods of inactivity is one of the most remarkable features of mechanical refrigeration and makes it especially adaptable in this field. By the use of large brine storage tanks the energy, whenever available, can be transformed into refrigeration and as such stored in the brine, which can be then utilized whenever wanted within certain limitations. This brine storage tank in refrigeration takes the place of the storage battery in the power plants and it does it in an infinitely more efficient manner.

Now in order to see the extent to which this development is likely to progress and the extent to which changes are likely to come a review of the entire engineering field would be necessary. It is a fact that there exists scarcely one power-plant engineer who is at all familiar with refrigerating engineering. That these two subjects are bound to come into closer and closer connection is a foregone conclusion. The developments in mechanical refrigeration of the last few years are such that this extension into power plant production seems to have scarcely commenced and it seems desirable that power-plant engineers should become more familiar with the outlook from a refrigerating point of view.

In order to do this we must look at mechanical refrigeration from a broad aspect. There exist to-day two forms of efficient refrigerating machines; both utilize the boiling of ammonia to produce the refrigeration. The compression plant, however, utilized a compressor and a water cooler to produce the liquid ammonia. An absorption machine utilizes the absorptive power of water for ammonia gas, and the loss of this power with rise in temperature, to produce the same result. Now in actual practice the compressor is superior in efficiency for small units. In large units the absorption machine far surpasses the compression machine in almost every respect. Ice can be manufactured at less than 50 cents a ton by the absorption machine and an equivalent refrigeration produced at a much less cost. The compression machine ranges somewhat higher but in small units is superior from a first cost point of view. The efficiency of both types of machinery, however, depend largely on the kind of refrigeration required, whether mild or extreme refrigeration is the object sought. The compression machine loses rapidly in efficiency with a diminution in the temperature required, whereas an absorption machine remains practically constant with regard to this factor.

Power plant design when it has utilized refrigeration at all, has almost in every case installed the compression system. The reason for this is that it utilized excess power. The power was produced by engines and dynamos and its utilization was best available by means of a motor running the compressor. This could be turned on or off whenever desired and the only change from an ordinary refrigerating plant of this type was the utilization of an abnormally large brine storage tank.

The fact of the matter is that the absorption machine has been developed to such an extent that a machine can be operated to-day from the exhaust of a corresponding compression plant of equal capacity, and some authorities put its capacity under these conditions at almost twice this value. Formerly the absorption plant could only utilize fairly high pressure steam and was very inefficient in operation owing to faulty designing and almost total lack of knowledge of the essential physical constants required in regard to the relations existing between water and ammonia gas at various temperatures and pressures. Since then, and it has been practically within the last decade, the absorption machine, which was formerly a rather disreputable member in engineering circles, has been developed to such an extent that its superiority is now recognized. The ability to utilize exhaust steam is one of its most important features. Whereas a compression plant with compound condensing engines has a certain efficiency, an absorption machine utilizing the same steam has an efficiency almost 50 per cent superior; and a combined machine of the same capacity—the compression machine exhausting into and operating the absorption part by exhaust steam—has a capacity almost double the original plant. The absorption machine cannot utilize high pressure super-heated steam efficiently. It utilizes the latent heat of steam and this varies with the temperature so that the quantity of heat in high pressure superheated steam is only slightly greater than that in ordinary steam. Thus we come to the possibility of the elimination of the compound condensing engine in refrigeration production and the best development from an efficiency point of view by the utilization of simple engines driving a compression plant and the further utilization of the exhaust steam from these in an absorption plant. This has been proved in actual practice to be nearly 100 per cent superior in refrigeration produced to a compression plant of the same rated capacity with compound condensing engines.

Rectifier for Electric Locomotives.

On page 927 of our issue for November 10 a brief account was given of a system of electric traction proposed by MM. Auvert and Ferrand, engineers of the Paris-Lyons-Mediterranean Railway, in which the current supplied is alternating, while direct-current motors are used for driving the locomotive. The locomotive is equipped with a special form of "regulating rectifier" which receives alternating current at constant voltage and delivers direct current at a voltage which can be varied at will according to the demands of the driving motors. The novel feature of the system resides in the "regulating rectifier," the mechanical construction and electrical characteristics of which are discussed below.

Fig. 1 gives a schematic representation of the circuits of the "rectifier" reduced to a two-pole model. The commutator is made up of two large conducting segments which are connected directly to the alternating-current slip rings and between which are joined the two parts of the rectifier winding, in addition to numerous small conducting segments tapped to the rectifier windings at regular intervals. The two pairs of the rectifier winding surround a continuous magnetic circuit, shown in the illustrations as being similar to a Gramme ring, but the parts are so arranged that current which passes from one large commutator segment to the other flows in such a way as to produce two magnetomotive forces in series in the magnetic ring. Thus when an alternating e.m.f. is impressed between the two slip rings, the windings and the magnetic circuit act in every respect like the primary winding and core of an alternating-current transformer, or, as the equipment is used, as the single winding of an auto-transformer. The small commutator segments serve as the contact devices for taps from the auto-

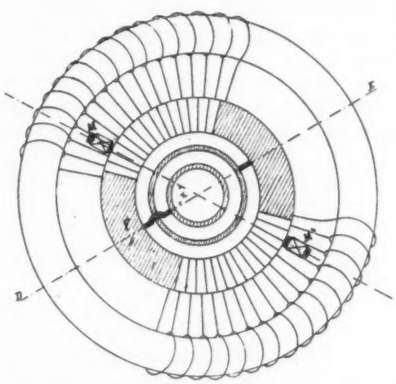


FIG. 1.—DIAGRAM OF TWO-POLE MODEL OF RECTIFIER.

transformer. Two brushes are arranged to bear continuously upon the commutator, which as noted above is formed of the two terminal pieces and the intermediate contacts of the auto-transformer. The addition of means for driving the commutator and auto-transformer in synchronism with the alternations of the supply current completes the essential details of the rectifier.

It will be apparent from a study of Fig. 1 that with the two brushes placed diametrically opposite each other the instantaneous value of the e.m.f. between them will depend upon their mechanical position with reference to the terminal pieces of the auto-transformer, and upon the value of the e.m.f. impressed between the terminals. If when the alternating e.m.f. has its maximum value the synchronously rotating element is in the position to cause each brush to be in the center of a terminal piece, then the time-value of the e.m.f. between the brushes will be similar to the heavy curve of Fig. 2, provided the alternating e.m.f. has a time-value similar to the dotted curve. Thus the delivered e.m.f. is unidirectional but fluctuates in value from a certain maximum to zero twice during each cycle of the alternating e.m.f. A little further consideration will show that the delivered e.m.f. can be given any value desired from the maximum to zero, by decreasing the arc of separation between the brushes from 180° to zero. In practical operation the voltage impressed upon the direct-current motors is varied throughout the required range by shifting the brushes on the rectifier; on account of this characteristic of the machine it has been given the name "regulating rectifier."

As intended for railway use the machine differs in minor details from the simple bi-polar model described above. Fig. 3, which is a diagram of the electric circuits of a rectifier equip-

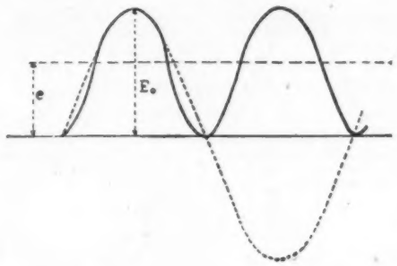


FIG. 2.—RELATION OF IMPRESSED AND DELIVERED ELECTROMOTIVE FORCES.

ment designed for railway work, shows that the high-potential alternating current is fed in parallel to two step-down transformers whose secondaries are connected to the slip rings of two distinct rectifiers, the delivery circuits of which are joined in series. The series connection of the delivery sides of the rectifiers is desirable on account of the fact that each machine operates better at a lower than at a higher e.m.f., and the e.m.f. necessary for traction is greater than the value that can con-

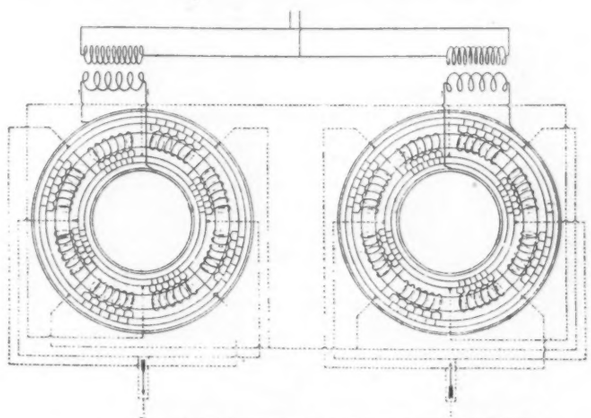


FIG. 3.—INTERCONNECTIONS OF ELEMENTS OF RECTIFIER.

veniently be obtained from one rectifier. It will be seen from Fig. 3 that each rectifier is provided with two commutators and two distinct sets of auto-transformer windings. This construction has been adopted for mechanical symmetry, and in order that the core material may be economically utilized. The two auto-transformer windings can be arranged for series-connection, although the arrangement is somewhat simpler when they are connected in parallel, as shown in Fig. 3.

A plan view of two "regulating rectifiers" directly geared to a synchronous motor is given in Fig. 4, while a longitudinal sectional elevation of one of the rectifiers is shown in Fig. 5. It will be noted that the revolving element of each rectifier resembles somewhat the armature of a rotary converter except that it is provided with two commutators. A striking difference in mechanical details is found, however, in the fact that there is no part to correspond to the field structure of the rotary, and the machines are essentially different electrically in that there is no transformation of electrical into mechanical power and the rectifier proper is incapable of maintaining itself in motion. The synchronous motor serves merely to revolve the rectifier at synchronous speed, and it is relatively small in size.

The rectifiers shown in Fig. 4 have a combined direct-current

capacity of 400 kw at 235 volts, the alternating e.m.f. impressed upon each rectifier being 155 volts, the efficiency at full load being 91 per cent. By shifting the brushes the e.m.f. can be

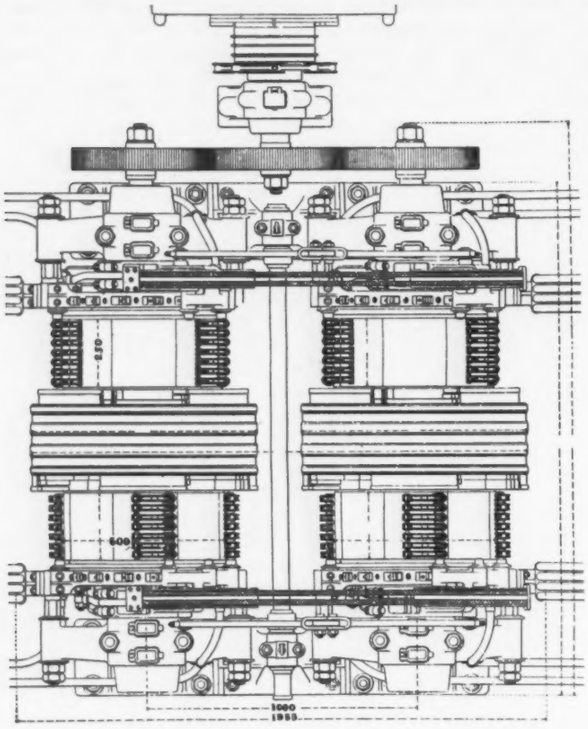


FIG. 4.—PLAN VIEW OF RECTIFIER.

varied from 20 to 280 volts with a constant supply pressure of 165 volts. It is stated that the commutation is excellent at

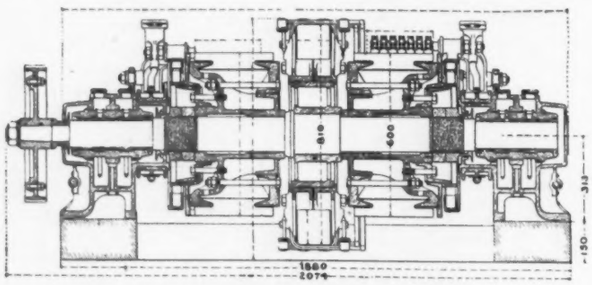


FIG. 5.—LONGITUDINAL SECTION OF RECTIFIER.

1,500 amp., and that loads of 2,100 amp. have been carried without difficulty. The locomotive to utilize this rectifier is now being built for the Paris-Lyons-Mediterranean Railway by the Alioth Electric Company, of Paris.

Arc Lamp Carbon.

A United States patent issued January 1, 1907, to August Kufferath, of Beuel, Germany, relates to a form of impregnated carbon for arc lamps used for photographic purposes. The inventor adds to carbon about one half to one per cent by weight of a mixture of equal parts of yttrium nitrate and lead nitrate. It is claimed that while these carbons do not differ from others with respect to luminosity and current consumption, they are considerably superior with reference to their actinic power. Carbons prepared in the manner described above burn quietly without the production of slag, and the light obtained from them is rich in violet rays. It is stated that the actinic intensity, which is quite independent of the intensity of light, is a function of the atomic weight.

High-Tension Insulators for Railways.

The Vereinigte Isolatorenwerke Actiengesellschaft, of Berlin-Pankow, Germany, whose pioneer work in high-tension insulation was described in the July 14, 1906, issue of this paper, has just brought out a line of insulators for high-potential railway service. They are made under the Kleinsteuber patents. The metal cap in these insulators is distinct from the bell, which is made of insulating material, and is molded into a threaded ring which screws into the cap. This construction allows a long distance between the cap and the insulated bolt and reduces

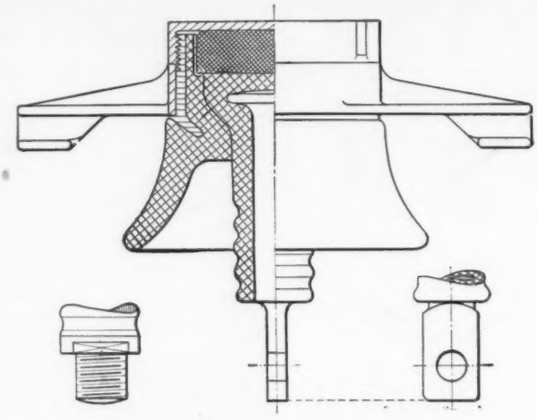


FIG. 1.—INSULATOR USED ON TANGENTS.

surface leakage. Between the head of the insulator bolt and the metal cap there is a disc of insulating material. The lower end of the bolt varies in form according to the type of suspension adopted for the wire. Fig. 1 shows an insulator used on tangent and Fig. 2 one for curves. The insulation of the trolley wire from the line insulator suspension is really double; first, because the insulator bolt is molded in insulating material, and second, because the bolt is also surrounded by a housing of insulating material.

During a dry test of the insulator shown in Fig. 1 no arc between the trolley wire and suspension took place until the e.m.f. was from 48,000 to 50,000 volts at 50 cycles; and in an artificial rain there was no arc until the potential exceeded

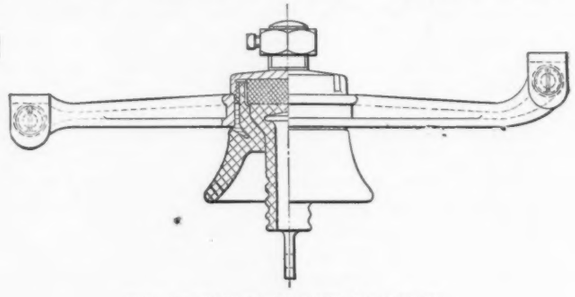


FIG. 2.—INSULATOR USED ON CURVES.

20,000 volts. When tested for mechanical strength the insulators showed that they were capable of withstanding a vertical pull of 2,500 kg. (5,500 lb.) without any deformation other than a light bending of the suspension arms. After this test the insulator was subjected to 20,000 volts for half an hour, yet no electrical defects were discovered.

When insulators are to be used on installations of from 12,000 to 15,000 volts they are bolted to the bracket or cross arm from 1 meter to 1½ meter (3 ft. 3 in. to 5 ft.) apart. A span wire is then connected to the lower end of the bolts of the side insulators and the trolley insulator is hung from its center. The suspension is therefore flexible, but the insulation is quadruple, since each insulator in itself is doubly insulated. For potentials under 10,000 volts an arrangement less elaborate than this is sufficient.

Similar construction is used for curves, except that the insulator to hold the curve is so constructed that it cannot slide on the span wire. This method may also be used for catenary construction, in which event the lower end of the trolley insulator bolt is furnished with a clamp for the messenger cable, and the trolley wire is then suspended in the usual manner. To prevent the trolley wire from getting out of position at curves, the hanger wire is replaced by a piece of pipe, the lower

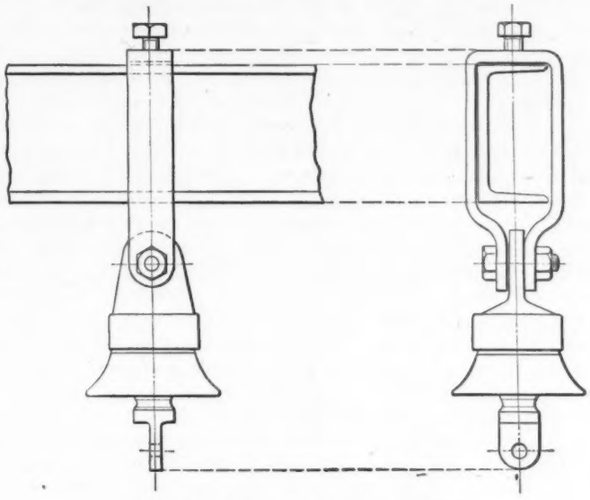


FIG. 3.—HINGED HANGER SUPPORT.

end of which is connected by a guy wire and strain insulators to the insulator on the outer side of the curve.

Fig. 3 shows a construction for catenary lines having a trolley voltage of from 1,000 to 5,000 volts, where only one insulator is needed. In this case the insulator can be attached directly to the bracket or cross arm. The clamp for the messenger wire is on the lower end of the insulator bolt. In this instance it is not necessary to have a flexible suspension for the trolley wire, as the connection of the latter to the catenary is such that bow-type current collectors will have no difficulty in maintaining contact.

New Telephone Patents.

MACHINE RINGING DEVICE.

For some parts of telephone service it is the utmost advantage to reduce the responsibility of the operator as much as possible. In accomplishing this a most important step is the introduction of machine ringing whereby, having once depressed the ringing key on a connection, the responsibility of the operator ceases, ringing being automatically accomplished at regular intervals. Of course a response must automatically discontinue the ring, and this has usually been done by leading the ringing current supply through an electromagnetic trip. For certain kinds of selective ringing such an arrangement will not work because of the disturbing effect of the inductance of the trip coil. This is particularly so with harmonic selective systems. To obviate this difficulty Mr. W. W. Dean, of Elyria, Ohio, has adapted a thermic control. A thermostat under the influence of a non-inductive coil in the ringing circuit serves by indirect means to control the trip. One of these means suggested is a pneumatic action with the valve moved by the thermostat. Mr. Dean has obtained a patent assigned to the Dean Electric Company.

SUB-STATION EQUIPMENT.

S. C. Houghton and F. M. Potter, Jr., of Syracuse, N. Y., are responsible for two adaptations of a receiver with a long specially shaped U magnet. The first is a hand microphone in which the receiver magnet extends the entire length of the instrument. The parallel limbs form a foundation for the handle grip and afford a space between them for the hand switch. A loop at the turn of the magnet holds the stem of the transmitter case so that this latter may be fastened in position. In the second adaptation the loop of the U is bent at right angles to its normal plane. With a wall set this loop is secured to a swivel member attached to the back board, and so placed that the permanent receiver magnet serves as a receiver supporting arm. The Wire & Telephone Company of America has been assigned both these patents.

Fig. 1 shows a sectional view of a transmitter patented by F. W. Fahrenfeld, of Rochester, N. Y., his patent being assigned to the Simplex Telephone Manufacturing Company. This is almost a reversion to first principles. The electrodes are saw-

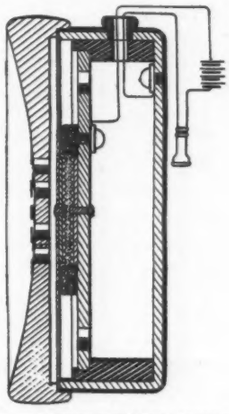


FIG. 1.—FAHRENFELD TRANSMITTER.

toothed to give a large surface and a felt packing ring is used. The novelty lies in details of construction.

A patent assigned to the same company has been granted to G. Babcock, of Rochester, for a portable set. The receiver of the watch case type is surrounded by a spring, the ends of which project to form an open circular band in which the transmitter may be clamped when not in use. The transmitter mouthpiece is made like a pocket drinking cup and when collapsed the whole set is very compact. The cords from the set lead to a pocket battery and lamp signal case. The circuit control lies in a switch within the receiver case, but operated by a projecting button so placed as to be clamped in when the transmitter is in its holder.

Fig. 2 shows in section a receiver patented by L. Steinberger, of New York. The spherical cavity equally divided by the diaphragm and the singular ear piece are certainly novelties.

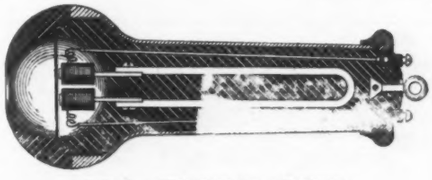


FIG. 2.—STEINBERGER RECEIVER.

The inventor claims a peculiar augmentation of the volume of sound produced due to this design. However, all early experiments and almost universal practice have indicated the flat air film as essential to clearness.

A telephone set with a novel receiver forms the subject of a patent granted to S. J. Post, of Birmingham, England. Two receivers are used, connected together by a large bow spring of a size to span the head with slight pressure. To use the receivers one is placed at either ear and hooks similar to those of a pair of spectacles are looped over the ears to hold the receivers up in place.

T. P. Jordan, of Dallas, Texas, has devoted his attention to a station signal. This comprises a special drop with its operating coil in parallel with the bell and a restoring coil controlled by a switch.

Two patents have been granted for sound confiners for trans-

mitters. The basic principle in each is a screen surrounding the regular mouthpiece and fitting against the face in a position not to disturb the lips. The adaptations are very different, one providing for sanitary reasons a distance between lips and mouthpiece to prevent contact. This is the invention of E. Stempel, of San Francisco, while the other is patented by J. G. Kitchell, of New York City.

CALL METER.

N. M. Holland has invented a manually-operated call meter system with the registering device at the subscriber's premises. The operating conditions require that the user have the right to call in without registering, which latter may be omitted altogether if the connection fails. To accomplish this result the circuits are led through the call apparatus and are here normally open. A shunt is, however, provided around this open through a thermostatic relay. In making a call the shunt is used, but when sufficient time has been used to place the call the relay is heated and opens the shunt, whereupon the station transmitter becomes cut out until the register is pushed.

AUTOMATIC EXCHANGE CIRCUIT.

It has been found where an automatic exchange has trunks to a manual exchange that special provision should be made for calling back the manual operator. This is ordinarily impossible as the earlier response has made the trunk show busy on the automatic and it cannot be reached with an operator plugged in a distant end. Where there is more than one trunk the operator may be called up again over the first trunk not busy, but this is cumbersome. A. M. Bullard has patented an arrangement of circuit controlled by a special key by which the calling station may ring the distant manual exchange at will. The patent has been assigned to the Western Electric Company.

CALL DISTRIBUTING SYSTEM.

An operating system in which the work is distributed according to function among several classes of operators has been patented by J. A. Aven, of Stockholm, Sweden. The system contemplates switching operators at annunciator boards, who extend calls to answering operators by direct extension. These latter then pass the details of the call over a circuit to connecting operators who sit in front of a multiple of both lines and trunks and thus can put up any desired connection. The system includes a complete arrangement of lamp signals to indicate what operators are busy at any particular instant.

PARTY-LINE SYSTEM.

A lock-out party line on the dissected line principle has been patented by H. J. Roberts, of Evanston, Ill. In this system one side of the line is in sections, the breaks being at the station, while the other is normally continuous. It is necessary for the central to build up the line when any station is required, electromagnets being provided at each station to actuate the necessary switches.

SWITCHBOARD IMPROVEMENTS.

With the subdivision of large exchanges in densely populated districts the matter of trunking between branches becomes the most important feature of operating, representing by far the greatest proportion of the business. For such service practice everywhere has settled upon the one-way trunk manipulated by a switching or B operator in response to requests over a calling circuit and to the indications of lamp signals. H. L. Reber, of St. Louis, Mo., has found difficulty where the traffic is such as to require more than one calling circuit between two points. This difficulty is the equal distribution of the load between the circuits, the personal equation completely upsetting the law of chance. He proposes that each connection to a calling circuit by any operator shall set a signal in front of every other operator having access, to indicate the busy condition. At first sight this seems satisfactory. However, the actual communications over the call circuit are so brief that for any efficiency many times more than one operator should be on the circuit awaiting turn. It is only when the number of waiting operators is too large that real difficulty arises.

G. M. T. Piltz, of Stockholm, Sweden, has invented a two-wire switchboard circuit system in which the novelty lies in the line and cut-off relays. The cut-off relay cuts off the line signal and cuts in the line relay so that this latter becomes effective as one of the necessary battery feed retardation coils.

Letter to the Editors.

Wireless Telegraphy.

To the Editors of Electrical World:

Sirs:—Is it not irrational that the name "wireless telegraphy," etc., should signify what is not used (wire) rather than something that is used in connection with this means of signal transmission? The case is similar to that of the automobile before it came into popular use, when it was spoken of frequently as the "horseless" carriage. Why mention wireless or horseless? If the operation of the telegraph is dependent upon ether, why not call it the ether telegraph or apply a similar rational designation?

Spokane, Wash. Robert K. Howard.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Commutation.—Bailey and Cleghorne.—The conclusion of their paper on some phenomena of commutation. The authors discuss the distribution of the magnetic field and the influence of circulating currents in a motor with commutating poles and then deal with the determination of the current in the segment under the brush, actual measurements being made by the authors. One result is that the current density under the brush is little affected by the circumferential size of the brush. The whole line current passes through the leading segment, even though the larger portion of the brush is touching the segment behind. Excessive brush ratio serves no useful purpose and there is a strong case against low current density, because the anticipated decrease in the e.m.f. will not be obtained while the idle part of the brush is merely wasting power in friction and may also be the seat of heavy circulating currents. The leading edge of the brush is really the important part from the current-carrying point of view and the trailing edge should be reduced to its narrowest limits. The leading half should be of the best and most heavily graphitized carbon, and possibly the metallic impregnations sometimes used would be still better. The trailing half, however, should have a much higher resistance, preferably obeying Ohm's law as nearly as possible. The author emphasizes that the brush has far more power to commutate a current than is generally believed.—Lond. *Elec.*, December 21.

Single-Phase Machines.—Sumec.—A theoretical paper on the armature reaction in single-phase generators.—*Elek. u. Masch.*, December 9.

Measuring Temperature Rise.—Loppe.—An article on the measurement of the rise of temperature in the windings of dynamo-electric machinery with notes on the rules of the national American, German and French electrical societies on this subject.—*L'Industries Elec.*, November 25.

Losses in Armatures.—Press.—A mathematical article on the distribution of the losses in the iron and on the production of heat in and rise in temperature in armatures.—*L'Eclairage Elec.*, December 15.

Lamps and Lighting.

Selective Radiation in Incandescent Lamps.—FRANKLIN.—Some notes on the new high-efficiency lamps and the question whether selective radiation is effective in the same. The author points out that "the idea of selective radiation is profoundly modified in most illuminants and made to depart widely from that form of the idea which is based upon thermodynamics, where the idea grows out of the necessarily complementary character (in a substance nearly in thermal equilibrium) of emission, transparency and reflection." The author distinguishes selective excitation and selective radiation. Selective excitation is due to the fact that when energy is imparted to a substance it may spread out very slowly among the various possible modes of molecular motion and if the substance is losing energy continuously by radiation there must be a very wide departure from black body radiation because of the wide and persistent departure of the substance from thermal equilibrium. The extent to which the radiation from a selectively excited substance departs from black body radiation or rather from its own characteristic normal emission (when it is nearly in thermal equilibrium) depends greatly upon the speed at which the energy of a given mode of molecular motion spreads out into all the possible modes, and we have evidence that this speed of spreading is very slow even in many solid and liquid substances. When energy is imparted to a glowing substance by the electric current, whether the substance be solid or liquid, or gas, we have in all probability a strongly marked case of selective excitation. "The upshot of this whole matter is that in the solution of the important problem of the efficient production of light we are not constrained by the thermodynamic laws of radiation, and not to a very great degree dependent upon selective radiation properly so called, but we are left free in the field of unlimited possibilities of selective excitation."—*Science,* December 21.

Experiments on Carbon, Osmium and Tantalum Lamps.—MORRIS.—An account of measurements in which the author first tested the effect of variation of voltage when the lamps were

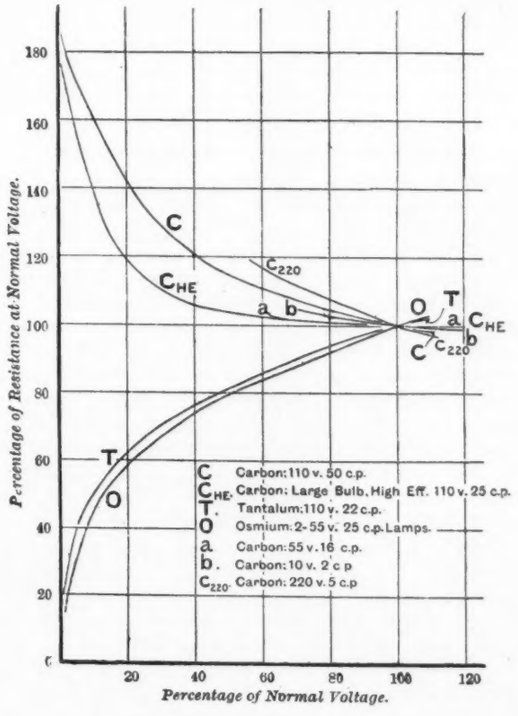


FIG. I.—LAMP VOLTAGE CURVES.

supplied with direct current. With ordinary carbon lamps a rise in pressure of one per cent means a rise in candle-power of from 6 to 7 per cent, while the corresponding rise in candle-power is only 4½ per cent for osmium lamps and 4⅓ per cent for tantalum lamps. Fig. 1 shows the relation of resistance to voltage for various filaments, while the ratio of hot resistance to cold resistance is 0.56 for the carbon filament, 6.3 for the tantalum filament and 7.9 for the osmium filament. On this account metallic filament lamps will have a decided effect on a machine running on a lighting load. If for any reason the pressure fails and the whole load is switched on again at full voltage (the normal current being, say, 100 amp.), then the momentary current on closing the switch will be for carbon filament lamps from 50 to 60 amp., while for tantalum lamps 630 amp. and for osmium lamps about 790 amp. These effects are largely diminished by the inductance of the circuits, but with a metallic filament lamp load the effect should be plainly noticeable in the increased sparking at the brushes of the generator and at the switch contacts. The author then describes tests of the instantaneous variation of candle-power when the lamps are supplied with alternating currents. He found the following values for the percentage variation of candle-power (defined as difference of maximum and minimum divided by mean). For a frequency of 30 this percentage variation was found to be 28 for the tantalum lamp and 64 for a 220-volt, 5-cp carbon lamp, while for a frequency of 60 it was 15.5 for the tantalum lamp, 27 for the 220-volt, 5-cp carbon lamp and 12 for the 110-volt, 25-cp carbon lamp. The author finally studied the ratio of mean spherical to mean horizontal candle-power and the considerations which affect the life of lamps. It is an interesting fact that for thin filament lamps working at low frequencies the mean candle-power obtained from a lamp on a direct-current voltage is not necessarily the same as the mean candle-power of the same lamp running on an alternating-current voltage of the same root—mean square value.—Lond. *Elec.,* December 14.

Calculations of Illumination.—BLOCH.—The conclusion of his article. After some notes on the calculation of mean hemispherical candle-power and on calculations of interior lighting and street lighting the author gives several numerical examples showing how to apply his numerical tables.—*Elek. Zeit.,* December 13.

Power.

Gas Analysis.—KERSHAW.—In the conclusion of his serial on gas analysis for steam users he gives instructions on the practical application of the gas test results. He shows how to calculate the total heat losses due to the volume and specific heat of the exit gases; the heat losses due to imperfect combustion; the heat losses due to air leakage; and the heat losses due to aqueous vapor. When all the losses have been calculated the heat balance sheet may be drawn.—Lond. *Elec.,* December 21.

Electric Dredge.—MEINERS.—A fully-illustrated description of an electric dredge for use on the Weichsel River. Electricity is used for all power purposes and lighting.—*Elek. Zeit.,* December 30.

Traction.

Canal Haulage.—An illustrated article on electric haulage on the Canal d'Aire et de la Deule at Doual, France. The ratio of barge section to canal section is high, being 1 to 3.8 or 3.3. For this reason the tractive effort is also high, being 3 lb. per ton at a speed of 1.9 miles per hour, which is the maximum speed at which loaded barges are permitted to travel on the canal. The total length of the canal is 58 km. On the main part of it (43 km.) the Denefle tricycle is used. Its new model weighs 2.5 tons; its efficiency was only 42 per cent when towing a single barge at 3.27 km. per hour during the tests, since with the towpath in the bad condition in which it is now on many sections, the power taken to drive the tractor alone is very considerable. In view of this high power consumption a rail track has now been laid on the remainder of the towpath (16 km.). Even in spite of the greater weight (8 tons) of the locomotives the power taken to haul the tractor alone is less than 2,000 watts, against 13,000 watts for the tricycle. Electric towing has no monopoly along this canal and horses are still used in some cases, in addition to steam tugs. The use of the different systems of haulage on the same canal in actual practice is said

to "emphasize the advantages of the electrical method."—Lond. *Elec.*, December 21.

Electric Railways in Italy.—A note stating that considerable progress is being made in the electrical equipment of existing steam railways in Italy. The contract for the equipment of the line through the Giovi tunnel on the Milan-Genoa line, about 5½ miles in length, has been awarded to the Westinghouse Company. The total cost is estimated at $1,200,000. Another line soon to be electrified is that through the tunnel under the Apennines betwen Savona and St. Giuseppe, the equipment for which will be supplied by Ganz & Co., of Budapesth. The Italian State Railways are also considering the introduction of electric locomotives in the sections Turin-Modane and Pistoia-Poretta on the Florence-Bologna line.—Lond. *Elec.*, December 21.

Single-Phase Traction.—A fully-illustrated description of the equipment of the cars for the Vienna-Baden Railroad. Within the cities through which they pass the cars are operated with direct current at moderate speed, while outside of the cities they are supplied with alternating current and are run at high speed. The same cars pass over both systems. The article is fully illustrated.—*Elek. Zeit.*, December 13.

Regenerative Control.—Raworth.—A communication pointing out the fact that with cars using the regenerative control system the energy taken directly from the line to propel the car, and neglecting the energy put back into the line, is less than when the same cars are fitted with series motors. The cause of this is said to be found from a study of the question of acceleration. The tendency of all series motors is to go on accelerating until the reduced current and the load are in equilibrium; consequently on all fairly level portions of a tram line the driving is done by successive acceleration and coasting, including a good deal of hand braking. It is obvious, therefore, that the maximum speeds are much in excess of the mean running speed. Some figures are given from actual practice to corroborate this argument.—Lond. *Elec.*, December 21.

Johannesburg.—A note stating that the large new municipal generating station at Johannesburg, South Africa, which is to supply tramways, lamps and motors over an area of nearly 100 square miles, is now approaching completion. Producer gas is used with gas engines of respectively 1,000 hp and 2,000 hp.—Lond. *Elec.*, December 14.

Permutators.—A long illustrated description of permutators of the Rouge & Faget type and their application on locomotives for converting alternating current into direct current, which is supplied to direct-current traction motors.—*L'Industrie Elec.*, December 10.

Installations, Systems and Appliances.

Rotary Converters.—Walker.—A discussion of the relative advantages of rotary converters, motor-converters (cascade converters), synchronous motor-generators and induction motor-generators. The four types are compared with respect to starting, parallel running, variation of voltage, hand regulation of voltage, compounding, commutation, risk of breakdown, power factor, efficiency, floor space and cost. The conclusions of the author are decidedly in favor of the rotary converter. In the discussion which followed some speakers expressed their preference for the cascade converter. Peck said that it is not a new idea. It had been considered by Mr. Lamme as far back as 1898, and that very carefully. The Westinghouse Company is in a particularly favorable position as regards patents on this question, and as soon as its engineers believe that the motor-converter is cheaper to build or more efficient in operation they will take it up and build it in preference to the rotary, but not before."—Lond. *Elec.*, December 14.

Storage Battery in Three-Phase System.—A description of the three-phase current distribution system of a potassium salt factory in Germany. There are three alternators of 150, 50 and 35 kw, respectively. The three-phase currents generated have a voltage of 1,000. The motors are directly operated at this voltage, while the lamps are fed from transformers in which the voltage has been reduced to 110. It is stated that it has been found in such factories "that the chloride powders attack more readily direct-current conductors than alternating-current conductors, since the latter type of current does not produce electrolytic action." For this reason an alternating-current system was selected. A storage battery of 50 cells is provided of such a capacity that it can supply the network for at least three hours with 30 to 35 kw. The arrangement is shown in Fig. 2. *A* is

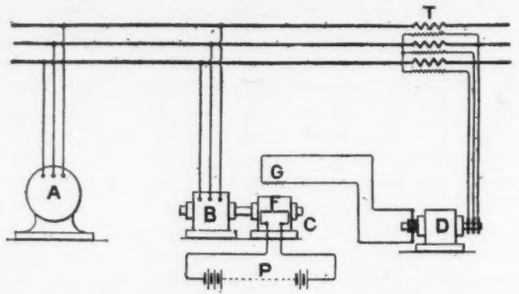


FIG. 2.—STORAGE BATTERY IN THREE-PHASE SYSTEM.

a three-phase generator. *T* is a transformer in series with the line. Its secondaries are connected to the converter, *D*. The direct current generated by the latter is proportional to the load in the three-phase network and is used to excite the shunt dynamo, *C*, which is part of a motor-generator set. When the load in the line increases the voltage of *C* decreases and the battery, *P*, drives the machine, *C*, as motor, *B* being generator and supplying three-phase currents into the network. On the other hand, when the load in the line diminishes, the voltage of *C* increases and the battery, *P*, is now charged from *C*.—*L'Industrie Elec.*, November 25.

Melbourne.—An abstract of last year's financial account of the Melbourne municipal central station. There were sold 4,460,000 kw-hours against 3,980,000 last year. The works cost per kw-hour was 3.166 cents (against 3.756 cents). The total cost, including management charges, but excluding capital charges, was 3.618 cents (against 4.142 cents), the total cost including capital charges was 6.278 cents (against 7.046 cents).—Lond. *Elec.*, December 21.

Capital Charges.—Miller.—A paper read before the Manchester Section of the British Inst. Elec. Eng. on capital charges, depreciation and rating of electricity supply undertakings.—Lond. *Elec.*, December 14.

Units, Measurements and Instruments.

German Reichsanstalt.—A brief abstract of the annual report of the German Reichsanstalt for 1905. In experiments with cadmium standard cells it was found that differences in the size of the grains caused differences in the solubility and that these result in differences in the e.m.f. A great many periodic voltage curves were analyzed by means of the Blondel oscillograph using a resonance method of Pupin. Many tests of standard cells were made. The voltage of the Weston cell was found to be between 1.0187 and 1.0195. The difference between the international ohm of the British National Physical Laboratory and of the German Reichsanstalt was found to be +0.00004 ohm. In a comparison between magnetization by direct current and alternating current it was found that the difference is due partly to eddy currents and partly to magnetic viscosity. Of great importance will be the extensive work as to the effect of chemical composition and heat treatment on the magnetic properties of iron alloys. These researches will be made in connection with the German Association of Electrical Engineers, several German steel plants, the laboratory for metallurgy of iron in Aachen and the Royal Bureau for Testing Materials, and it is expected that the researches will be finished in five or six years. In the use of constantan-copper and constantan-iron thermo cells it has been found to be a disadvantage that the copper and iron wires corrode too quickly on account of oxidation. A proposition of Siemens & Halske to substitute pure silver for the above materials has proven quite satisfactory for temperatures even up to 650° C. Some quartz glass, metal

vapor lamps of Heræus were tested; especially the lamps containing pure cadmium or zinc are quite valuable for certain spectrometric, etc., work on account of the large number of very strong lines.—*Elek. Zeit.*, December 20.

Testing.—EPSTEIN.—The conclusion of his illustrated paper on the selection and testing of materials for construction of electrical machinery. He gives various notes on temperature tests, tests of losses, etc. Concerning efficiency determinations, he says efficiencies measured directly and indirectly coincide, as a rule, within the limits of the error of the observations, which is about 1 to 1.5 per cent. He therefore prefers the simple and more exact method of the separate loss measurements. It is, moreover, his opinion that this method should be used for calculating guaranttees, as it is important that guarantees should be capable of being checked in a simple and unobjectionable manner. In the discussion J. S. Peck thought that the standard given by Prof. Epstein for testing iron is a very good one. He expressed the opinion, however, that a temperature of 100° for the ageing of iron is too high, as a plant is not generally run at that temperature, and that 80° would be more suitable. Ageing at 110° is not necessarily the same as ageing at 80°. With regard to the testing of insulation, the importance of this consists really in seeing that the insulation is in proper condition; for example, free from moisture. Mordey gave some further information on the special iron alloys alluded to by the author. They were discovered by Hadfield and Barrett, and improvements had been effected by Hadfield and Sankeys. The alloy has been sold under the name "stalloy" and its behavior for different thicknesses is especially remarkable. "At a thickness of 0.024 in. 10,000 *B*, 50 periods, the total energy loss in the new material is less than one-half what it is in the best obtainable iron. Ordinary practice is to use iron sheets 0.014 in. in thickness. The new material 0.05 in. thick gives about the same loss as the 0.014 iron." From the new alloy steels marked effects on transformer design may be expected.—Lond. *Elec.*, December 14.

Suspension for Galvanometer.—In a galvanometer exhibited by Paul at a recent exhibition of instruments before the British Phys. Soc. a new kind of suspension is used, as illustrated in Fig. 3. The suspension is provided with springs which main-

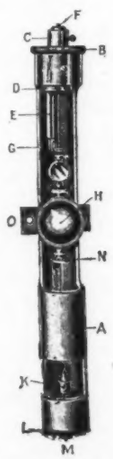


FIG. 3.—SUSPENSION FOR GALVANOMETER.

tain the suspension in tension and render the instrument particularly suitable for places where the vibration is such as to prevent the use of a freely suspended coil, and the coil is accurately balanced so that the galvanometer can be used at sea. The magnet is circular with flat pole faces and a ring-shaped coil is used surrounding a spherical core. The moving system is mounted in a brass tube which can be drawn out at any time without the necessity of undoing the connections. The rotating plug, *B*, contains a plnger, *C*, normally pressed upwards by a spiral spring and furnished with a flange, *D*, into which the stud, *E*, is screwed. The latter projects upwards through the flange, and passes into a slot in the lower surface of the plug, *B*, allowing the spring to tighten the suspension. By depressing the plunger and giving it a slight turn to one side or the other the stud, *E*, is removed from the slot in the plug, and can then be locked into one or other of two recesses at the side of the slot, removing the strain from the suspension and at the same time locking the coil frame against the core, *H*, by means of the spring, *G*. The lower suspension strip is of the same length, and is interchangeable with the upper strip. The screw, *M*, provides a means of raising or lowering the plunger, *K*, for centering the coil. The apparatus is particularly suited for use as a "speaking" galvanometer for reading signals through submarine cables.—Lond. *Elec.*, December 21.

Mercury Plug Contact.—In a description of a "self-testing" Wheatstone bridge exhibited by the Cambridge Scientific Instrument Company before the British Physical Society, a new form of mercury contact plug for resistance boxes, devised by Collins, is described. It is illustrated in Fig. 4. Each of the

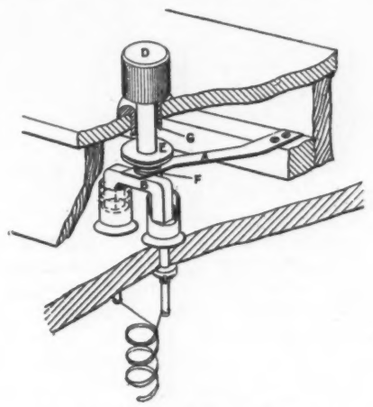


FIG. 4.—MERCURY PLUG CONTACT.

copper bridges, *B*, for short-circuiting the resistances can be caused to dip into mercury cups by allowing the heavy plug, *D*, to rest upon the disc, *E*. This is normally held up by the spring, *A*, against the bush, *G*, which renders the apparatus dust tight. The cups are so arranged that if the bridge is accidentally inverted no mercury is spilt.—Lond. *Elec.*, December 21.

Measuring Variations of Speed.—At a recent exhibition of apparatus before the London Physical Society a new chronograph was shown for recording variations of speed of engines. A drum covered with smoked paper is coupled to the engine shaft through two universal joints of a special design free from backlash. The tuning fork, which is employed to give a helical trace on the drum, is mounted on a carriage guided to move axially, and so arranged that a single movement places the style in contact with the paper and at the same time engages the lead screw in a way similar to the mechanism of the ordinary phonograph. A divided circle is engraved on one end of the drum. The tuning fork is not provided with an electromagnet to keep it in constant vibration, but it will vibrate sufficiently long to give clear indications over the greater part of the 24 revolutions which carry it from end to end of the drum. The position of the tuning fork can be set by a screw adjustment, magnifying glasses being provided to facilitate this.—Lond. *Elec.*, December 21.

Flame Standards.—PEROT AND JANET.—An account of determination of the comparative values of the three flame standards: Carcel, Hefner, Vernon-Harcourt, made in two Paris laboratories. The results of three determinations by direct comparison are as follows: Ratio of Vernon-Harcourt to Carcel = 1.009; ratio of Hefner to Carcel = 0.0926; ratio of Hefner to Vernon-Harcourt = 0.0927. If reduced to standard atmospheric conditions, namely, a content of 10 liters of steam per cubic meter for the Carcel and the Vernon-Harcourt and 8.8 liters for the Hefner, the above three figures become 1.009, 0.0832 and 0.0933, respectively. By means of indirect methods the following three values were found 1.000. 0.00929 and 0.0929.—*Bull. Labor. d'Essais*, Paris, 1906, No. 9.

The Installation of Alternating-Current Generators.

Engineers in charge of power stations, as well as students of electrical engineering, will be interested to read the instructions for installing alternating-current generators, recently prepared by the Allis-Chalmers Company, for the use of its customers, which are reproduced in part herewith.

At the outset it is stated that all of the generators built by that company belong to the revolving-field class. They are made in five types designed as "belted," "water-wheel," "engine," "fly-wheel," and "turbo," the last-named being for direct-connection to steam turbines.

The mechanical construction varies to some extent with the size and type of generator, so that it is not practicable to give a description that will apply to all these machines. In most cases, however, the general arrangement is as shown in Fig. 1, which explains itself. The method of arranging the coils and interconnecting them varies with the number of phases for which the machine is built, the voltage, etc. Fig. 2 shows a portion of the winding for a three-phase machine with coils arranged the same as in Fig. 1. For lower voltage machines where it is not necessary to have such high insulation, the winding is frequently of the two-layer type shown in Fig. 3. All the coils are of the same shape and each side occupies only half a slot, one side lying in the upper part of one slot and the other in the lower part of another slot. The field coils of all except some of the smaller machines are of bare copper strip wound on edge with adjacent turns separated by tough insulating paper. In some small machines it is necessary to wind the field coils with square copper wire in order to admit of excitation at 120 volts.

The location of the generator is usually fixed beforehand by the position it must occupy relative to the engine or shafting. There is, therefore, little choice as to this, but it is always desirable to install alternators, or in fact any electrical machinery, in a clean dry place where there will be plenty of light and room. Good ventilation is important, since the better the ventilation the lower will be the operating temperatures of the machine. There should not be any combustible material near the alternator and the location should provide for sufficient head room to permit taking the machine apart.

The foundation on which an alternator rests should be firm and substantial, in order to prevent vibration and secure smooth running. Small belted machines below 100 kw can, if necessary, be set on heavy timber supports, but a concrete or brick

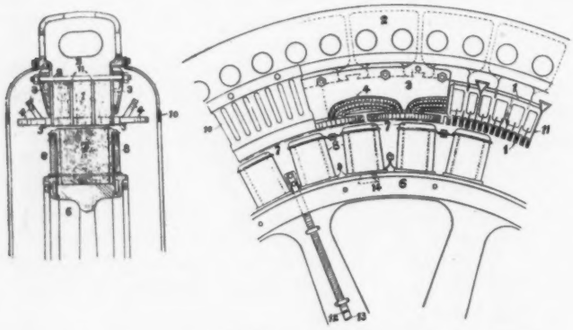
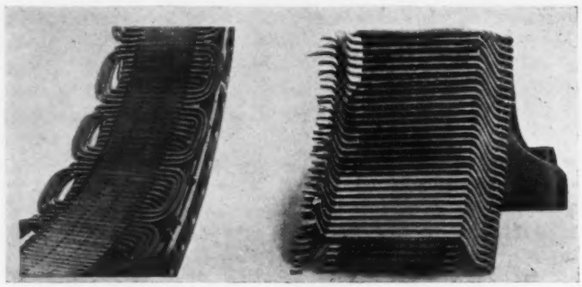


FIG. 1.—CONSTRUCTION DETAILS OF ALTERNATING-CURRENT GENERATOR.

foundation is preferable; all machines above 100 kw must be provided with concrete, brick, or masonry foundation, concrete being the most suitable. Concrete for this purpose can be made in the following bulk proportions: Sharp sand, 2 parts; broken stone, 4 to 5 parts; Portland cement, 1 part.

The foundation should be heavy enough to secure freedom from vibration and, in building it, provision should be made for foundation bolts to hold the base, rails, or sole plates of the machines. In making the foundation, place iron pipes in the approximate locations that the foundation bolts will occupy, using pipe having an inside diameter of at least two inches larger than the foundation bolts, to allow adjustment. Pockets should also be arranged in the foundation to give access to the anchor plates and bottom nuts on the foundation bolts. After the alternator has been permanently located, thin cement should be run into the pipes thus fixing the bolts accurately in position. Foundation bolts should be located by templates made from outline prints of the machine. The top of the foundation should be leveled off as accurately as possible and the cement allowed to set before the machine is placed in position.

The National Board of Fire Underwriters favors the insulation of generators from the ground wherever it is feasible. Such insulation is generally provided by a substantial wooden frame or wooden stringers under the rails, the wood being well filled and varnished to prevent absorption of moisture. This is practicable with small belted generators, but with heavy machines or those direct-connected to steam engines or



FIGS. 2 AND 3.—CHAIN AND TWO-LAYER WINDINGS.

water-wheels complete insulation from the ground is practically impossible and it is better to ground the frame positively by means of a heavy copper wire connecting the frame from a water pipe or other convenient ground. In other words, the frame of a machine should either be thoroughly insulated or thoroughly grounded so that there will be no doubt about its condition.

With belted machines static electricity is frequently generated by the belt, thus charging the frame of the machine if the latter is thoroughly insulated from the ground. This static electricity is generally removed by arranging a comb or series of metal points close under the belt and connecting them to ground. The points can be easily supported on iron pipes, as shown in Fig. 4.

The generators must be thoroughly protected against lightning and high potentials due to static electricity. The lines should be equipped with lightning arresters and in cases where high potential static electricity is liable to accumulate, dischargers should be provided to carry it off.

SETTING UP BELTED MACHINES.

The rails should be placed in position, approximately leveled, and wedged up so that the weight of the machine will be distributed evenly. If the alternator is small and comes completely assembled, it can now be set on the rails, carefully leveled, and lined up with the driving pulley.

If the machine is of large size and shipped in two or more parts, place the base on the rails and set the stator in position, first making sure that the planed surfaces on the base and feet of the stator are perfectly clean and oiled to prevent rust. Most of the larger belted machines are arranged so that the stator can be shifted to one side to give access to the field and armature coils, and when the stator is first set on the case it is advisable to locate it so that it will be to one side of the field core when the latter is placed in position. All bearing surfaces should be thoroughly cleaned before the shaft is placed in the bearings; if there are any rough or rusty spots on the journals, they should be removed with crocus cloth; see that the oil wells are thoroughly clean. When placing the rotor in position, watch the oil rings carefully to see that they do not get jammed and bent out of shape; after the rotor has been

placed, put the caps of the bearing pedestals in position and bolt down firmly. The stator can now be slid into position over the rotor and bolted in place; if there are any dowel pins in the feet of the stator, see that they are in place before the cap bolts are screwed down. Fill the bearings with a good quality of mineral oil to the proper height as indicated by the oil gauge.

Put the pulley on the shaft, and line the whole machine up

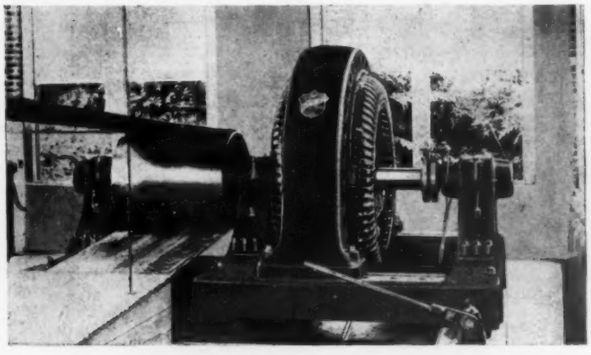


FIG. 4.—BELTED TYPE ALTERNATOR.

with the driving pulley. If possible run the machine with a rather slack belt and adjust the alignment while running so that the belt runs on the center of the pulley and allows the rotor to oscillate freely in its bearings.

Tighten down the foundation bolts and "grout" the rails by making a thin, easy-flowing mixture of one part of Portland cement and one part of sand together with sufficient water, and pouring it under and around the rails; small clay dams can be used to keep the thin cement in place until it hardens.

WATER-WHEEL TYPE MACHINES. (FIG. 5.)

The foregoing directions regarding belted machines apply for the most part to water-wheel alternators also, except that the latter have no rails, and the base is set directly on the foundation. In this case the machine must be lined up accurately with reference to the water-wheel so that the halves of the flange coupling will fit exactly. After lining up by means of wedges under the base, the foundation bolts should be tightened and the base well grouted in. Use plenty of wedges and place them under both the inside and the outside edges of the base so as to give a firm and even support. In some cases where the water-wheel alternators are of large diameter and

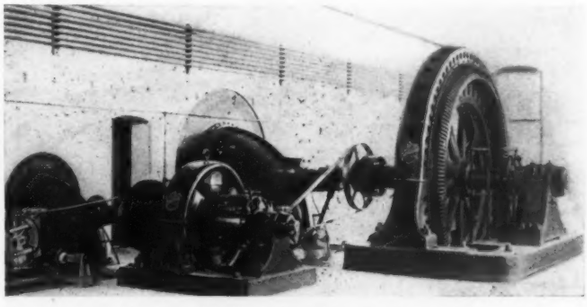


FIG. 5.—ALTERNATING-CURRENT GENERATOR, WATER WHEEL TYPE.

run at low speed, no base is provided. The stator and bearing pedestals rest on sole plates bolted to the foundation in the same manner as described below for engine type alternators.

ENGINE TYPE MACHINES (FIG. 6).

With engine type alternators the stator yoke rests either on an extension of the engine bed, as with some of the smaller machines, coupled to high speed engines, or on sole plates set on suitable foundations. The stator sole plates are made in two parts, the lower one being bolted to the foundation, while the upper plate is adjustable to facilitate centering the stator with respect to the field core.

Locate the sole plates temporarily in position and support them on iron wedges to allow for further adjustment. Place the lower half of the stator in position and level it approximately by means of the leveling screws in the upper part of the sole plate. In case the stator is arranged to shift sideways on the base or sole plates, set the stator to one side

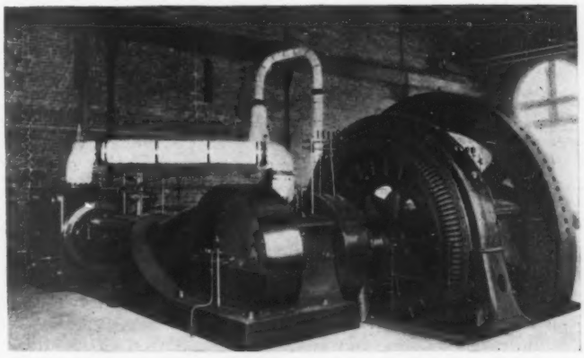


FIG. 6.—ENGINE TYPE ALTERNATOR.

so that it will be away from the rotor when the latter is placed in position.

Locate the revolving field core and engine shaft in the bearings, observing the same precautions as given under belted machines. In case the engine shaft has not been pressed into the rotor spider at the factory and it is necessary to do this work on the ground an expert machinist should be employed.

Place the top half of the yoke in position, first making sure that all planed surfaces are perfectly clean. Carefully center the stator with respect to the rotor by means of the adjusting screws in the feet and sole plates, and measure the air-gap between the stator face and the pole pieces at a number of points around the circumference; it is very important to have the air-gap uniform, as otherwise the frame will be subjected to an unbalanced magnetic pull causing bad operation.

The large water-wheel and engine-type alternators where the stator is split, it is usually necessary for convenience in shipping to disconnect and remove a few of the stator coils at the two partings in the frame. These must be carefully put in

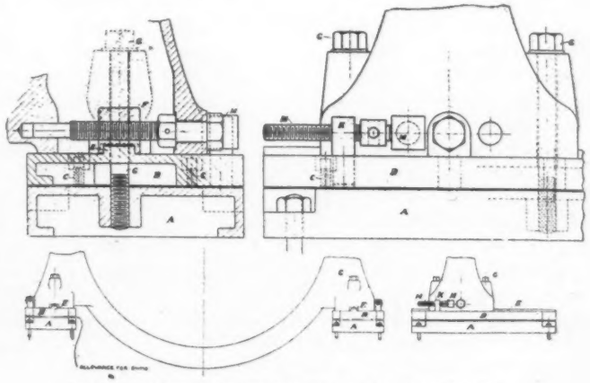


FIG. 7.—ADJUSTABLE SOLE PLATE OF ALTERNATOR.

place and properly connected. The coils must not be bruised and all connections should be neatly made and insulated to correspond with those for the other coils.

In aligning the yoke see that the center of the armature laminations is in line with the center of the pole laminations; if they are not in line there will be a side thrust on the shaft. After the yoke has been finally adjusted insert shims between the upper and lower parts of the sole plates so as to take the weight off the leveling screws. Drill and tap holes in the lower sole-plate to receive the holding-down bolts for the

stator, and bolt the latter securely in place. Fig. 7 shows the construction of adjustable sole-plates. *A* is the lower plate bolted to the foundation, and *B* is the upper adjustable plate; *CC* are the leveling screws. The yoke is held in line by spline, *E*, and by means of a bolt threaded into block, *F*, the yoke can be shifted in a direction at right angles to the shaft. For sliding the yoke sideways along the sole-plate a jack screw, *H*, turns in nut, *K*, and bears against a plug, *M*, that fits into a hole in the stator foot. Parts *H*, *K* and *M* are removed after the stator has been shifted to its final position.

Grout-in the sole-plates and after the cement has set, tighten the foundation bolts and carefully check over the alignment of the machine. If at any time the engine bearings are adjusted or realigned the air-gap between stator and rotor must also be checked over and the stator lined up, otherwise an uneven air-gap will result or the rotor may even rub on the stator.

Russell Engines.

The accompanying cuts illustrate several of the types of steam engines made by the Russell Engine Company, Massillon, Ohio. Fig. 1 shows the enclosed self-oiling type. Being enclosed, the working parts are protected against damage by dirt or dust and the lubrication of every moving part is automatically maintained. The wearing surfaces have been made very large, and while means have been provided for the "take up" and adjustments of wear, it is stated that practically no more attention need be given to the engine than that of turning on and off the steam, except at such long intervals as it is deemed necessary to examine and clean up machinery generally. For this ample means has been provided for easy access to the interior parts.

The tandem-compound type is shown in Fig. 2. The high-pressure cylinders are placed next to the bed, mainly to facili-

FIG. 1.—ENCLOSED SELF-OILING ENGINE.

tate access to the cylinder next the bed in case of repairs, without having to remove the outer cylinder. In case the high-pressure cylinder is to be inspected it can easily be done through the low-pressure cylinder, everything being so arranged as to come out that way. Another feature is the combined cylinder support and receiver, by which joints are reduced to a minimum, and strains avoided due to the expansion and contraction of the cylinders under different temperatures and pressures. This latter is accomplished by carefully facing the bottom of the cylinder support and having the holes for the base bolt elongated to allow coming and going as the condition of the cylinders may require. The engine bed is very heavy and the metal disposed in such a way as to secure the greatest stiffness with a given weight. An incidental advantage arising from heavy beds is that they absorb shocks from working in such a way as to allow very little tremor, which conduces to long life and smooth, successful working. The guides are of the cylinder type, and as they are bored on the same centers as the cylinder, it follows that the alignment is perfect and the friction of either piston, crosshead or rod is reduced to a minimum. The pillow block is bored to receive the "anti-friction" metal-lined bushing in which the shaft runs, which permits of a renewal of a bearing without removing the shaft.

The valve is balanced in all positions and is double-ported both for steam admission and for exhaust, the former taking place at the ends and the latter on the inside of the valve. By this arrangement twice the steam opening and twice the exhaust opening of a single port valve is obtained with a given travel.

A special mixture of iron is used for the cylinders and valves of Russell engines, and every heat taken in the foundry is recorded and test bars taken from each heat at three different periods. These test bars are analyzed as to tensile strength, hardness, deflection, contraction and general appearance.

A piston head of very strong yet light construction is used, with two snap rings, between which is a band of anti-friction metal to act as a shoe or carrier of the weight of the piston. It is stated that so successfully does this band perform its duty that among the fifteen thousand engines built by the Russell Engine Company no case of a cut cylinder has been known. The anti-friction metal band expands just enough more than the iron of the piston to prevent its coming in contact with the cylinder walls; the snap rings do the packing and prevent steam leaking by the piston. Means are provided for the inser-

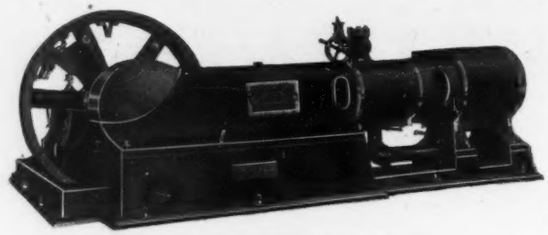


FIG. 2.—TANDEM-COMPOUND ENGINE.

tion of a spanner by which the piston rod may be screwed into or out of the crosshead to adjust the clearance between cylinder heads and piston at each end of stroke.

The crosshead slippers or shoes are easily adjusted to any position of rod. The wrist pin is placed at the center of the crosshead, thus distributing the pressures from the connecting rod and piston rod evenly over the whole wearing surface. The crosshead wrist is flattened top and bottom to prevent a shoulder forming by the action of the connecting rod. The wrist is held by a nut and taper ends and can be removed without taking out the crosshead. The connecting rod is a steel forging without a weld. At its crosshead end it is supplied with phosphor-bronze boxes while at the crank end gun metal boxes are used lined with anti-friction metal. The eccentric strap is lined with anti-friction metal and provided with means for lubrication from within the bed as well as by hand at the pleasure of the operator. The length of the eccentric rod is adjustable at the strap, and the valve rod is adjustable for length both at the rocker arm and valve nut.

The governor is adjusted for whatever speed or direction

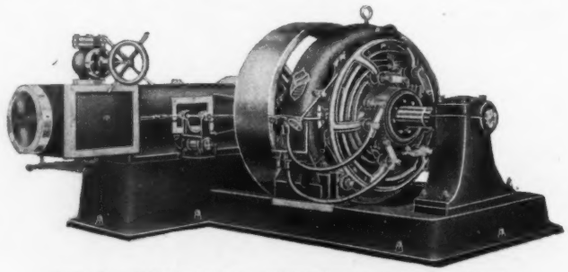


FIG. 3.—SINGLE-VALVE AUTOMATIC CUT-OFF ENGINE.

that may be desired. By increasing the tension of the spring the speed is increased; by adding weight at the long end of the weight arm, being the portion that is down, the speed will be increased; and by adding weight at the other or upper end the speed will be reduced. This arrangement of spring and weight makes the governor extremely sensitive, and also so controls the speed of the engine that it cannot run away no matter to what amount may be the sudden change of load.

The Russell Engine Company also builds a four-valve engine, known as the semi-Corliss type, tandem and cross-compound, and a single-valve automatic cut-off engine (Fig. 3) arranged

for direct connecting to electric generators and also arranged for belt and rope drive. The MacKay Engineering Company, 29 Broadway, New York City, has secured the agency for the Russell Engine Company for the East.

Centrifugal Pumps.

One of the chief advantages of the centrifugal pump resides in the fact that its speed is so high that it may be direct-connected to an electric motor. Due to its high speed a direct-connected centrifugal pump occupies a small space for a given capacity, which feature is of great importance in mine work.

The accompanying illustrations show sectional views of a pump which has been designed with special reference to obtaining high efficiency at high speed. In this pump the passage route along which the water finally finds it way to the outlet has the form of an Archimedes spiral; that is, the cross-section increases in an arithmetic ratio up to the full area of the discharge. Thus the kinetic energy of motion of the water is used to the best advantage. This pump is built by the Buffalo Steam Pump Company, Buffalo, N. Y.

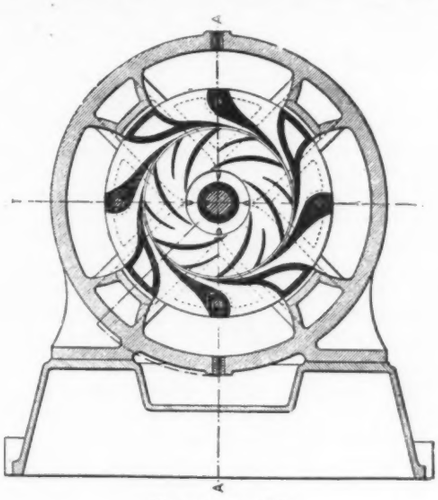


FIG. 1.—CROSS-SECTIONAL VIEW OF PUMP.

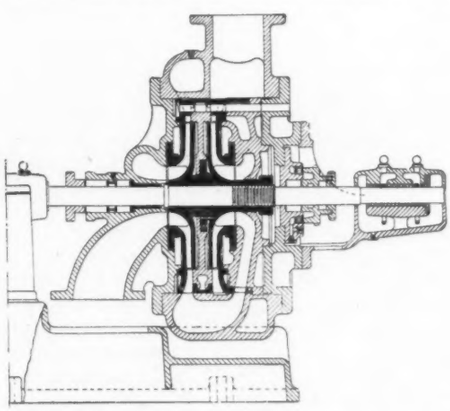
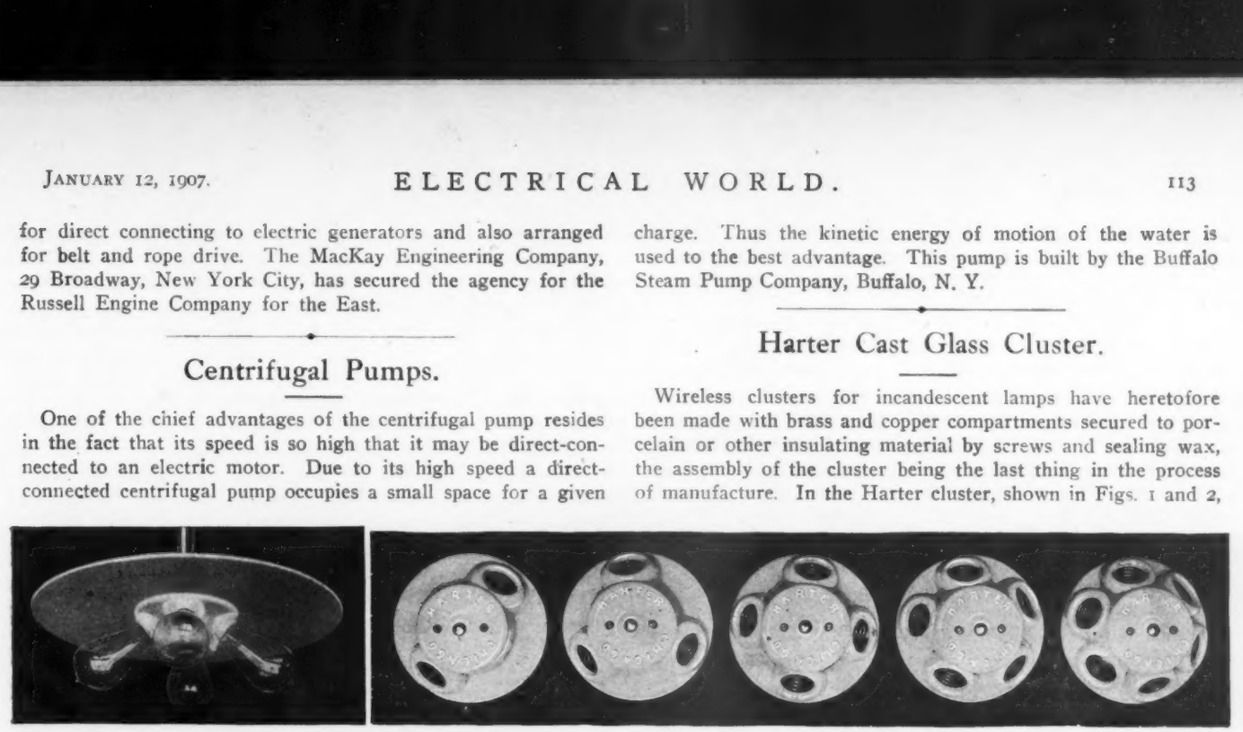


FIG. 2.—LONGITUDINAL-SECTION VIEW OF PUMP.

Harter Cast Glass Cluster.

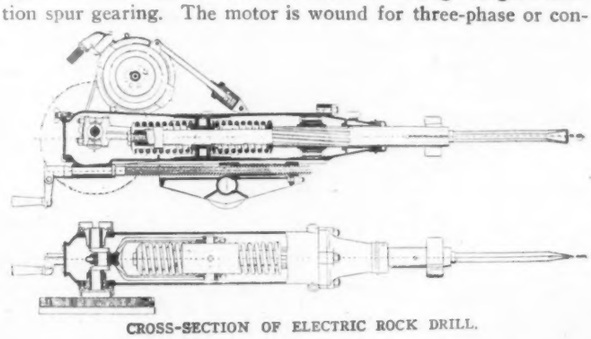
Wireless clusters for incandescent lamps have heretofore been made with brass and copper compartments secured to porcelain or other insulating material by screws and sealing wax, the assembly of the cluster being the last thing in the process of manufacture. In the Harter cluster, shown in Figs. 1 and 2, which has been recently brought out, the necessary metal contact parts are assembled the first thing and opal glass is cast around these parts. The result is a cluster in which the metal parts are solidly imbedded without any screws which can work loose in time. The construction is very simple, as it is only necessary to run two wires from a pair of binding posts, one wire being soldered to the brass shells into which the lamp bases screw and the other wire being carried around in a circle so as to be exposed at the bottom of each receptacle to form the center contact piece. The brass shells are soldered to the wire connecting them and the heat of the molten glass makes something similar to a brazed joint between the copper wire and the brass shell. The only screws used in the cluster are a couple of screws which hold on the bottom cap which covers the terminals and leading-in wires and two other screws which form the binding posts. Besides having the advantage of solidity and being in one piece, this opal glass, of course, never tarnishes and is easily cleaned. It is also an excellent reflector. It is made of a short piece of threaded pipe by which it can be attached either to a cast iron shade holder furnished with the cluster or to a flat ceiling plate. It is made in sizes from 2 to 6 lamps. The manufacturer is G. H. Harter, 146 5th Avenue, Chicago.



CAST GLASS CLUSTERS.

Electric Rock Drill.

The drill shown herewith is of the percussion type, yieldingly driven by an electric motor. The motor is mounted directly upon the drill frame and drives the drill through single reduction spur gearing. The motor is wound for three-phase or continuous current not exceeding 300 volts; the three-phase motor is considered preferable.



CROSS-SECTION OF ELECTRIC ROCK DRILL.

Combined with the motor is a suitable starter and friction clutch, the former being so arranged that the motor is first started light and allowed to attain full speed, the clutch being afterwards thrown in. The drill is thus brought gradually up

to speed. The clutch also serves to screen the motor from sudden shocks and overloads, a suitable spring device being provided in the clutch for adjusting it so that slipping will occur at a predetermined overload.

The construction of the drill mechanism is shown in the cross section drawing. It consists of a main reciprocating drill bar, which is driven by a connecting rod and cross head from the motor countershaft, heavy spiral springs being interposed between the cross head and the drill bar. The drill bar has cut upon it a screw thread working in a nut free to revolve in one direction, so that a rotary motion is imparted to the drill during its forward movement. The drill strikes from 400 to 500 blows per minute.

For ordinary working the drill is mounted upon a vertical column with screw extension. The screw extension is operated by a worm gear and ratchet lever, which enables the column to be fixed firmly in position with a minimum of time and labor. The method of attaching the drill to the column allows rotation of the former in either a vertical or a horizontal direction. The drill may be thus fixed at any desired angle.

This drill is made by Siemens Brothers, Stafford, England.

Chicago's Electrical Trades Exposition.

The second annual electrical show given by the Electrical Trades Exposition Company in the Coliseum, Chicago, January 14 to 26, will cover 30,000 sq. ft. of space. The building is to be elaborately decorated in purple and gold and many interesting diversions have been prepared to offset in a measure the trade aspect of the show. It is said that the majority of the exhibitors in this year's show have made elaborate arrangements in the preparation of their booths and displays. The Allis-Chalmers Co. and the Westinghouse Companies will each occupy nearly 1,500 sq. ft. of space. The Chicago Edison Company and the Commonwealth Electric Company combined have about 3,000 sq. ft. The Chicago Telephone Company and the American Telephone & Telegraph companies combined have about 1,200 sq. ft. The telephone manufacturers are stronger than a year ago. The Stromberg-Carlson Company, the Swedish-American Telephone Company, the Automatic Electric Company and Frank B. Cook each have about 600 sq. ft., and the Kellogg Switchboard & Supply Company has 300 ft. Other exhibits are as follows:

Electric Service Supplies Company, Chicago, Ill., will exhibit the "Automotoneer," which is attached to the controller of an electric car, and makes it necessary for the motorman to pause at each point of the controller, so that he cannot start the car suddenly.

The Phoenix Glass Company, Pittsburg and Chicago, will display large, varied and effective lines of electric lighting glassware, consisting of etched, rich cut, decorated and other effects; also its well known brand of "Phoenix quality" inner globes. Messrs. E. H. Fox and C. C. Fricke, of the Chicago branch, will be in charge.

National Electric Lamp Association will exhibit the latest achievements of electric lamp makers, in the display of the tantalum, tungsten, metallized and ordinary carbon lamps. The remarkable economy shown by the tantalum, tungsten and metallized lamp will be clearly and accurately demonstrated in a way interesting to the layman as well as the expert.

The Brilliant Electric Company, Cleveland, Ohio, will have on exhibition for the first time the "Brilliant" 44-watt lamp. The new tantalum lamp will also be exhibited as well as ordinary glass "B" lamp. It will also have on exhibition the tungsten lamp, the "Brilliant" Gem, the "Brilliant" tantalum, the standard tipped and tipless together with the "Brilliant" special and a complete line of miniature lamps.

The General Electric Company's exhibit will occupy the same location near the door as last year, and especial attention is to be given to incandescent lamps. Not since the Chicago World's Fair, in 1903, has this company made such an elaborate display of incandescent lamps as will be seen during the Coliseum exhibition. Its various Gem units, as well as tantalum and tungsten lamps, will be shown in the collection, making a dazzling display. There will be a comprehensive collection of standard lamps of all candle-powers and for all conditions, including miniature lamps of all kinds. Besides featuring incandescent lamps the company will make a fine display of electrical cooking and heating devices.

Joseph Dixon Crucible Company, Jersey City, N. J., will occupy Space 4, Section A. Few people realize what an important factor the Dixon products are at present, and what an important one they will be in the industrial world in the future. On exhibition will be crucibles for melting brass for casting; brushes made of pure graphite, which are self-lubricating, and which prevent sparking and commutator wear; pure flake lubricating graphite, graphite greases of all consistencies, to meet all conditions and requirements; graphite resistance rods of all sizes and all resistances as specified. Besides, there will be many other items of special interest to electricians, such as lamp cement, graphite for baking carbons and lamp filaments, graphite forms, pins, weights, etc.

National Battery Company, Buffalo, N. Y., will make a complete exhibit of storage batteries for all purposes, containing the many different sizes manufactured by it in capacities adapted to the different uses. In stationary batteries, the "Unit Accumulator" will be shown in the small "couples" or two-plate cells suitable for low discharge—such as small telephone exchanges and private branches, fire and police alarm, telegraph systems, and in laboratories, where an absolutely steady voltage is required. The larger sizes of "Unit Accumulator" will also be displayed in both glass jars and lead-lined tanks, suitable for larger telephone exchanges, railroad signal service, isolated lighting, and power plants of all kinds. The construction of the positive and negative plates will be shown in detail. The positive plate is a Planté plate made up of small, ribbed "units" welded to an antimonious lead frame, leaving expansion space on three sides, thus eliminating the possibility of the buckling of the plate or the breaking of the frame by the natural growth of the active portion. The negative plate is a staggered grid with an oxide mixture pasted into it, and is constructed to take care of the natural shrinkage by the use of a small pin running diagonally from the cross ribs into the active material, which keeps it always in the best of electrical contact and holds it firmly to the plate. Storage batteries suitable for lighting work on steam railroads will also be shown.

The Electric Storage Battery Company, of Philadelphia, will have a very complete exhibit of its various styles of "Chloride Accumulator" and "Exide" batteries, from the type "H," which when installed stands over five feet high, down to the small "BT" in glass jars, seven inches in height, which is used largely for telephones, fire alarm and telegraph work. One important feature of the exhibit will be the "R-85" tank, which is the same size as the eight batteries of this capacity now being installed for the New York Central & Hudson River Railroad Company in the electrification of its lines from New York to Poughkeepsie. This is also the same type of battery as that to be used in the colossal electrical plant, to be erected by the U. S. Steel Corporation at Gary, Indiana. The other tanks, beyond the type "H" referred to above, which is the standard cell used by the various Edison lighting companies, twenty-five complete batteries of this type now being used by the Chicago Edison Company; and the type "R," the type "G" used for railway and lighting work, the "F" type for lighting and telephone work; the "D" and "E" type for small lighting and telephone plants, and the "ET" and "BT" couples for other classes of electrical work. The Electric Storage Battery Company will also exhibit its various types of car lighting batteries, which it has developed to a great degree of excellence and also those for railway signal work. The "Exide" battery will be shown arranged for use in electric vehicles, both for propulsion and

ignition duty. There will also be a line of portable batteries for phonograph, medical and other applications necessitating the use of a compact portable cell. The exhibit will be in charge of the Chicago office staff, consisting of Messrs. G. H. Atkin, J. M. S. Waring, H. B. Marshall, W. F. Rath, W. F. Bauer and F. W. Hyde.

VULCAN ELECTRIC HEATING COMPANY, Chicago, Ill., will show high temperature electrically heated tools in full operation. Electrically heated tools of various sizes and shapes are included in the display and their practical value and economical operation will be clearly demonstrated.

W. N. MATTHEWS & BROTHER, St. Louis, Mo., will show what is known as the Lima jack box and plug, described in our issue of October 20, 1906. Another adaptation of the Lima jack box and plug, which will be exhibited for the first time in Chicago, will be its use in connection with the regular telephone service of a large city.

THE ANTISEPTIC COMPANY, Chicago, Ill., will have on exhibition a device at once simple and efficient in improving the conditions and removing the constant liability of contracting disease through the telephone transmitter. It is readily attached to the ordinary telephone and is said to protect the user from any contagion that lurks in all telephones.

THE STOLE ELECTROPHONE COMPANY, Chicago, will exhibit a pocket telephone for the deaf. This little instrument is not a trumpet or artificial ear drum, but an electrical device in two parts, transmitter and battery case in one, and ear-piece in the other, whose dimensions are as follows: Transmitter, 2⅜ in. diameter, ¾ in. thickness; ear-piece, 1⅞ in. diameter, ¾ in. thickness. Total weight of both parts, 11 ounces.

THE OHIO BRASS COMPANY, Mansfield, Ohio, will make a display of overhead electric railway supplies, such as trolley hangers, ears, etc., and will also have on exhibition a line of rail bonds, the distinctive feature of which is that the terminals are not castings or forged copper welded to the strand but are made from the strand. A section of the New York Central's third rail supported by the type of the third rail insulator which was furnished by the company, will also be on exhibition.

SHELTON ELECTRIC COMPANY, Chicago, will exhibit a vibratory massage instrument. An important advantage of which is the lack of vibration in the handle of the instrument with which it is moved about and can be applied to any part of the anatomy without disturbing the patient unduly, owing to its long flexible attachment cable. Its regulation is very simple. By turning a milled screw head at the small end of the frame the vibratory stroke can be made either very faint or intensely powerful, or anything between 5/15,000 per minute.

J. ALLEN HAINES, INC., Chicago, Ill., the Western manager of the Bishop Gutta-Percha Company of New York, will have the same exhibit as the Bishop Gutta-Percha Company showed at the Centennial Exposition in 1876 in Philadelphia, for which the Bishop Gutta-Percha Company received a gold medal. This will be an interesting historical exhibit. This company is also exhibiting radically new lines of electric heating material for all possible uses, including electric coffee percolators, electric tea kettles, as well as electric chafing dishes and hot water urns, laundry irons, etc.

WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., will have in operation a single-phase elevator motor, complete with controller. These motors are built by the Wagner Company in sizes from 5 hp to 25 hp, and are of such construction as to be susceptible of operation by the most unskillful of attendants. The inside construction of a transformer will also be shown and householders will be particularly interested in a little instrument which will tell how much it costs to operate an electric lamp, curling iron, coffee percolator, or any of the other energy consuming devices which they are using in their houses. To central station managers, engineers and others having an intimate knowledge of this subject, several new forms of instruments will be demonstrated. Variable-speed single-phase motors, vertical single-phase motors and polyphase motors will also be on exhibition.

FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., will have installed in one part of the building a motor-generating set of 150 kw capacity which will furnish all energy for exhibitors at the Electrical Show. This generating unit comprises a direct-current motor fed from the Chicago Edison Company's mains and belted to a 150-kw multiphase alternator. Aside from this special feature the company will have a regular exhibit in Space 13. The live feature of the exhibit will be a complete working demonstration of the Ft. Wayne series alternating-current arc lighting system of 25-light capacity. The company's standard line of supplies, types K and W single-phase, multiphase and prepayment watt-hour meters and its prepayment devices used separately with either their type K or W standard watt-hour meters will form part of the exhibit.

THE REYNOLDS DULL FLASHER COMPANY, Chicago, will show in operation an immense image of Lucifer. From a perfectly black background, there appears the outline of his Satanic majesty, in red lamps, in salute position, his right hand to his forehead and the forked tail wagging to and fro. Then as he disappears, instantaneously in its place, appears a skeleton in white lamps, 15 ft. high, standing in the same position. The skeleton salutes, and immediately proceeds to dance a jig half a dozen times, when he again straightens up and salutes, takes his head off his shoulders, holds it in his right hand, then throws it into his left and throws his head back and forth from one hand to the other half a dozen times. He finally puts it back on his shoulders, salutes and dances. He next straightens up again, takes his head off his shoulders and holds it in his left hand, then throws it down on his left knee, kicks it over his right knee, picks it up with his right hand and puts it back on his shoulders and instantly reappears again as his Satanic majesty in red lamps.

GUARANTEE ELECTRIC COMPANY, Chicago, will exhibit the new Kimble-Gregory variable-speed alternating and direct-current motors. The motors are designed for operating printing presses, air pumps, dental engines, jewelers' lathes and other small manufacturing tools that heretofore have seemed of too little importance to attract the attention of other manufacturers of motors. The motors for driving Gordon and Universal printing presses are unique in that the drive is obtained by putting the pulley of the motor in frictional contact with the flywheel of the printing press, and any speed can be obtained from 6 to 3,800 revolutions per minute by pressing a foot lever, no resistance of any kind being used. The electric forge blowers are also interesting. An aluminum turbine disc is mounted on the shaft of a variable-speed motor and suitably encased, and by simply moving a lever a pressure of from 1/10 oz. to 6 oz. per square inch is easily obtainable.

WESTERN ELECTRIC COMPANY will show at its booth a very large and handsome water color painting of its new 110-acre plant at Hawthorne, Ill. The exhibit will include American transformers, Thomas high-tension insulators, electric insulating material, Western Electric Company's arc lamps, and direct and alternating-current motors, the company's series-multiple lamps for both alternating current and direct current. The company makes a specialty of a direct-current indestructible lamp, the magnets of which are wound with Deltabeston magnet wire and will give a demonstration of the heat-resisting qualities of this wire as compared with cotton covered magnet wire. Another interesting feature will be that of a series of alternating-current equipment in full operation, including switchboard, regulator and transformers. The company will also show its new 1907 line of fan motors and a switchboard equipped with some recently perfected devices. An indestructible field coil for railway motors, wound with Deltabeston wire and guaranteed for one year, is an article which will form part of the display. The company's new 20-in. arc lamp will be connected up showing that fuses may be entirely omitted without injury to the lamp. A new induction motor recently perfected will be shown in actual operation.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—In distributive trade quietness prevailed, but in industrial lines there was great activity. Post-holiday and weather conditions affected both wholesale and retail trade, the latter line noting slackness in demand for heavy wearing apparel. Prices of staples show remarkable strength, and iron and steel, leather, raw wool, cotton and cotton goods displayed notable firmness. The New Year opens bright with promise in business circles, no excessive stocks being carried over, and results of inventories fully equal sanguine anticipations. In the leading industries, contracts on the books are very large and plants operate full time, except where materials or fuel cannot be secured or finished products cannot be forwarded to consumers. There is much complaint from Northwestern flour mills on this point, and export trade is also restricted because grain and other merchandise fail to reach the seaboard promptly. While the car shortage trouble is still very acute the country over, there are reports from a few sections, especially the Northwest and parts of the Pacific Coast, that grain and lumber are moving more freely. Car congestion is complained of, however, in the Eastern and Western coal trade, and affects cotton movement in parts of the South. Collections are good in the West; slow with extensions asked for in the South Atlantic States, and only fair in the Northwest. Active and strong conditions ruled the pig iron and steel markets at home and abroad during the week. In foundry iron from domestic makers the volume of business is large for prompt and forward. From the middle until the end of the week Southern foundry iron sales for the second half were made at advances over prices that held in the forepart of the week. Steel makers bought heavily toward the end of the week in Eastern and Valley irons. Bar iron is in increasing demand, with supplies available for all requirements. Prices are unchanged. Old materials are active and strong, especially for heavy steel melting scrap, old rails, cast machinery and cast iron. Prices are unchanged. Steel markets are intensely active, with increasing pressure for tin plate, black and galvanized sheets, pressed steel shapes, wire and wire products, heavy forgings, cast steel and tool steel and tools. Export trade is increasing in heavy machinery, wire and wire products, agricultural implements and tools. A number of important Canadian and South American buyers are negotiating for large specifications. Building operations have fallen off, but the railroads continue to place good contracts for structural shapes. The mills are sold up for the next three or four months. There were fewer business failures in 1906 than for twenty-two years preceding, says *Bradstreet's*, but owing to a few large bank failures, due to isolated cases of dishonesty, the liabilities were larger than in 1905. There were 9,384 failures, involving $123,827,927 in liabilities, a decrease of 6 per cent in number from 1905, but an increase of 1.6 per cent in liabilities. The proportion of assets to liabilities was 49.9 per cent, the smallest ratio since 1902. The number of those in business in 1906 was 49,000 larger than in 1905, but owing to the smaller number of failures reported, the percentage failing in 1906—the commercial death rate, in fact—was only 66 hundredths of 1 per cent, as against 71 hundredths in 1905, 1.40 per cent in 1896, 1.50 per cent in 1893, and the smallest death rate reported since 1880. Five bank failures—all due to dishonesty—accounted for one-sixth of all liabilities. The number of failures for the week ending January 3d was 185, against 161 in the preceding week and 220 in the corresponding week last year. Domestic and foreign copper markets reflected the strong statistical position of the metal, which is firmly consolidated under progressive and steady demands. For all deliveries Electrolytic business between producers and the large consumers is fetching 24½ and 25 cents. Prime Lake is in much larger demand than supply, with most producers of the larger tonnages sold out for several months. Latest important sales were made at 24⅝ and 25 cents. Casting copper is very scarce for requirements within sixty days. It is strong at 24½ and 25¼ cents. Ordinary grades in carload lots are fetching 25½ cents for prompt delivery.

CROCKER-WHEELER ORDERS.—The Crocker-Wheeler Company, of Ampere, N. J., notes the following among recent orders: Waynesboro Electric Light & Power Company, Waynesboro, Pa., one 300-kw, engine-type, alternating-current generator, 2,300 volts, 164 r.p.m., 60-cycle. Republic Iron & Steel Company, Youngstown, Ohio, one 200-kw, engine-type, direct-current generator, 250 volts, 100 r.p.m. Interstate Iron & Steel Company, E. Chicago, Ill., one 225-kw, engine-type, direct-current generator, 250 volts. Charles C. Morse & Co., San Francisco, Cal., one 200-kw, alternating current generator, 2,300-volt, ordered one 35-kw, 250-volt, direct-current generator, 300 r.p.m., citer. Williams Construction Company, Corinth, Miss., two 150-kw, engine-type, alternating-current generator, three-phase, 2,300-volt, 225 r.p.m; these generators to furnish power for lighting the city of Corinth. Crown Seal & Cork Company, Highlantown, Baltimore, Md., one 150-kw, direct-current generator, 125 volts, 225 r.p.m. Trimont Manufacturing Company, Roxbury, Mass., one 100-kw, belt-type, alternating-current generator, 240 volts, 600 r.p.m. National Tube Company, McKeesport, Pa., one 340-hp, 230-volt direct-current motor, 85 r.p.m.; four 125-hp, 2,300-volt, direct-current motors for driving pumps; six 15-hp, 230-volt motors. American Printing Company, Fall River, Mass., one 75-hp, 230-volt, direct-current motor, 530 r.p.m. American Wood Working Machinery Company, Rochester, N. Y., two 32-hp, 230-volt, direct-current motors; one 13-hp, 230-volt and one 10-hp, 230-volt, direct-current motors. International Silver Company, Bridgeport, Conn., eleven direct-current motors aggregating 162 hp. The Balance Cable Company has recently placed orders through the Millard Construction Company, of Jersey City, N. J., for six 40-hp, 500-kw crane motors. The Isbell Porter Company, of Newark, N. J., has also ordered one 35-kw, 250-volt, direct-current geenrator, 300 r.p.m., and one 12-hp, two 6-hp and one 5-hp direct-current motors for driving ice machines.

COPPER PRODUCTION.—Mr. D. Guggenheim, president of the American Smelting & Refining Company, in an article in the *New York Times*, states that he expects to see a gradual increase in copper output. He says: "The United States production in all probability will aggregate about 975,000,000 pounds, or an increase of only about 4 per cent for 1906 by comparison with 1905, as against an increase of 1905 over 1904 of 10 per cent. For 1906 the Canadian production will aggregate about the same as 1905, and Mexico will probably show a slight falling off. The chief increase in production for 1906 has come from Utah and California. A comparatively small increased production has come from the lakes and from Arizona. Montana shows a reduction in output for 1906. It is interesting to note that the production of copper in the world has doubled during the past ten years, and still it is all consumed. If we reason from the past we can readily believe even if the production increases again 100 per cent during the next ten years that the commercial and scientific development of the age will require all that the mines may produce. It has been said recently by eminent authority that the business of this country for the year 1907 is simply to be limited by the capacity of its various manufacturing plants, the capacity of the various transportation lines, and the supply of labor and capital. Similarly, we may expect as to the copper market a consumption equal to the greatest possible production, as no stocks of copper are in existence, and even the supply in the hands of manufacturers is at the lowest possible ebb. The price which will be established will be absolutely that required by supply and demand, as speculation cannot enter into the problem. Producers will only sell to consumers, and there are no stocks with which to speculate."

CHICAGO TELEPHONE gained 2,244 telephones in December, making a total of 170,833 in use in the Chicago Telephone Company's territory.

LIGHTING AT BENNINGTON, VT.—Mr. V. R. Lansingh, general manager of the Holophane Glass Company, says: "Perhaps as good an example as can be cited of the modern movement toward giving customers better illumination is the case of Bennington. This is a place of only 5,600 people with 9,000 incandescents on the circuits, but nearly 2,000 of these are equipped with the new Gem high-efficiency lamps with Holophane reflectors. The management under Mr. J. E. Larrabee, president and general manager, has not waited for customers to find out that better lamps than the old carbon type can be obtained, but has gone out of its way to push these modern lamps and endeavor to give the customer more illumination for the same or less expenditure of energy. The result has been that the standard of illumination in the town has been raised so that customers to-day are better satisfied than formerly and at the same time are spending more money for electric energy for lighting purposes. The company has endeavored not only to give the customers the new types of lamps and reflectors, but has endeavored to so place and select the same according to the modern principles of illuminating engineering as to give the customer the best possible illumination at the lowest cost. If the attitude of this company were adopted by all the electric companies throughout the United States, it would do more to still the cry for municipal ownership than perhaps anything else that can be done. It is also this attitude which makes it possible for the electric company to not only compete successfully with gas, but far outstrip it, despite the fact that first cost of installation is in many cases somewhat higher and the fact that the operating cost per candle-power is somewhat higher. It is interesting to compare this policy with that adopted a few years ago by most of the cities and towns throughout the country, when the electric company was interested in selling the customer so many kilowatt-hours at a given price rather than give the customer what he was really paying for, the best illumination."

THE BABCOCK & WILCOX COMPANY has bought from the Stirling Consolidated Boiler Company, as of December 31, 1906, its American property and interests, including all accounts and bills receivable, and has assumed its obligations and will execute its orders and contracts for boilers and appurtenances for installation and use in the United States. The plants thus purchased will be operated in the future by the Babcock & Wilcox Company under the name and style of "The Babcock & Wilcox Company (Stirling Department)," and will be operated under the direct charge and management of the same gentlemen who have operated the Stirling Consolidated Boiler Company. The men who have been connected with the Stirling Consolidated Boiler Company in its sales department will be associated with the Babcock & Wilcox Company in similar capacities. The Babcock & Wilcox Company (Stirling Department) will manufacture the Stirling, Aultman & Taylor and Cahall water-tube boilers and appurtenances heretofore manufactured by the Stirling Consolidated Boiler Company.

TIDEWATER ELECTRIC COMPANY.—The Tidewater Electric Company has secured county and city rights of way from Gadsden, Alabama, to Tuscaloosa, on the Warrior River, via Birmingham, for a freight electric railroad to the Tuscaloosa end, whence it purposes to barge coal to the Gulf down the Warrior and Alabama Rivers to Mobile, and thence by the Mississippi Sound and Lake Borgne Canal, to New Orleans itself. The Birmingham Railway, Light & Power Company has reached the limit of its expansion powers in Birmingham and is at work seeking a proper site for water power to deliver electrical energy to Birmingham. It operates one hundred and thirty miles of street railway, besides furnishing all the light and power for ten or more municipalities with over 200,000 inhabitants.

TELHARMONIUM CONTRACT.—A large number of hotel and restaurant contracts have already been made for the Cahill telharmonic music of the Electric Music Company of New York. Last week a contract was signed by the company and Willard Holcomb, business manager for Paula Edwardes. The "long-distance orchestra" has been installed in the lobby of the Casino Theatre, and patrons of the theatre have been treated to a free recital of airs from the opera for an hour before every performance, beginning with the opening of "Princess Beggar," last Monday. Miss Edwardes was the first operatic star to make practical use of "electric music" as an adjunct to her performance.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was firm but only moderately active. The daily sales of about 600,000 shares contrasted rather poorly with the million to million and a half share-markets which ruled in the early part of January a year ago. The main feature early seemed to be the uncertain position of the leading high-priced stocks of the Hill and Harriman groups, which had a rather weak tone and tended to recede on limited selling pressure. There was, however, no general disposition to work on the bear side, and it was largely a waiting market. The symptoms of easier money were offset by warnings that a period of permanently lower rates was not yet at hand. Predictions of gold exports due to the rise in foreign exchange did not, however, find much support. On the other hand, the raising of the Delaware & Hudson dividend from 7 to 8 per cent fell flat. Electric and traction shares showed more strength and prices are in the main higher. Westinghouse common closed with an advance of 5½ points, and General Electric closed with a gain of 1⅜ points. There was a resumption of the brisk trading in the copper shares on the curb and the market presented a more active appearance. Stocks continued to advance and further material gains were recorded, but the display of strength was succeeded in the later dealing by a sharp reaction, which in most cases greatly cut down previous advances. Following are the closing stock quotations of Jan. 9:

NEW YORK

	Dec. 31	Jan. 8		Dec. 31	Jan. 8
Allis-Chalmers Co.	16¾	16⅜	General Electric	160	160
Allis-Chalmers Co. pfd.	45	43⅜	Hudson River Tel	...	...
American Dist. Tel	...	...	Interborough Met. Com.	35¼	36⅛
American Locomotive	...	...	Interborough Met. pfd.	73½	73¾
American Locomotive pfd.	...	...	Mackay Cos.	69½	73⅛
American Tel. & Cable	85	85	Mackay Cos. pfd.	66¼	69
American Tel & Tel.	...	...	Marconi Tel	...	...
Brooklyn Rapid Transit	78¾	81⅛	Metropolitan St. Ry.	...	...
Electric Boat	30	30	N. Y. & N. J. Tel.	...	...
Electric Boat pfd.	73	76	Western Union Tel.	83¼	84
Electric Vehicle	...	...	Westinghouse com.	152	148
Electric Vehicle pfd	...	...	Westinghouse pfd.	...	...

BOSTON

	Dec. 31	Jan. 9		Dec. 31	Jan. 8
American Tel. & Tel.	134¼	133⅛	Mass. Elec. Ry. pfd	67	68⅛
Cumberland Telephone	...	...	Mexican Telephone	...	...
Edison Elec. Illum.	...	230	New England Telephone	126	...
General Electric	...	159¾	Western Tel. & Tel.	9	...
Mass. Elec. Ry.	18	19	Western Tel. & Tel. pfd.	...	80

PHILADELPHIA

	Dec. 31	Jan. 8		Dec. 31	Jan. 8
American Railways	50⅛	50¾	Phila. Electric	8	8⅛
Elec. Co. of America	10⅞	10⅞	Phila. Rapid Trans	20¼	20¼
Elec. Storage Battery	65	67	Phila. Traction	...	96
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Dec. 31	Jan. 8		Dec. 31	Jan. 8
Chicago City Ry.	...	160	National Carbon	85	...
Chicago Edison	...	...	National Carbon pfd.	11	...
Chicago Subway	...	...	Union Traction	...	5⅛
Chicago Tel. Co.	...	...	Union Traction pfd.	...	...
Metropolitan Elev com.	26	26			

*Ex-dividend

PACIFIC TELEPHONE.—Announcement is made that the Pacific States Telephone & Telegraph Company and the Sunset Telephone & Telegraph Company have been merged into one company, and that their various properties and systems, reaching every part of the Pacific Slope, will be taken over by a merger company called the Pacific Telephone & Telegraph Company. The consolidated company has been capitalized at $50,000,000. Of this there will be $32,000,000 in preferred stock and $18,000,000 in common stock. Great improvements are planned. While the merger has been in contemplation for some time it has only now been completed. The shareholders of the old companies met and voted the change, which thus consolidates Bell interests on the Pacific Slope.

DIVIDENDS.—Directors of the Union Traction Company of Indiana have declared a dividend of 1 per cent on the common stock, payable January 10. Directors of the Cincinnati, Newport & Covington Light & Traction Company have declared the regular quarterly dividend of 1⅛ per cent, payable January 15. Directors of the Philadelphia City Passenger Railway Company have declared a dividend of $3.75 a share, payable January 10. The directors of Ottawa Electric Railway have decided to pay the regular dividend of 8 per cent and a bonus of 4 per cent, the largest disbursement it has ever made. The directors of the Memphis Street Railway Company have declared a semi-annual dividend of 2½ per cent on the preferred stock.

HALL SIGNAL STOCK INCREASE.—A circular has been issued giving a plan for the sale of the Hall Signal Company to a new company with a capital stock of $10,000,000, of which one-half will be 7 per cent cumulative preferred and one-half common, par value $100 a share. The stock, plants, property, etc., of the Hall Signal Company are to be sold subject to a mortgage of $250,000. The assenting stockholders will receive for the capital stock now held by them payment as follows: The preferred stockholders will receive in payment preferred stock in the new company share for share and dollar for dollar, except that the stockholders owning preferred stock in the Hall Signal Company shall be paid $20 a share in addition to receiving one share of the preferred stock in the new company for one share of preferred stock in the Hall Signal Company. Of the stock of the new company 10,000 shares of preferred are to be sold at par and the proceeds placed in the treasury of the new company. The sale of 10,000 shares will be underwritten by J. S. Bache & Co. and their associates. Of the new company 20,000 preferred shares are to be reserved in the treasury for subsequent sale. The stockholders of the Hall Signal Company to the extent of one-half of their holdings shall have the first right up to and including January 20, 1907, to purchase the above 10,000 shares of preferred of the new company, paying cash therefor. The purchaser of each share of preferred stock shall be entitled in addition to one share of the common stock of the new company. The 50,000 shares of common stock of the new company are to be sold or used as follows: Ten thousand shares are to be set apart and issued to the purchasers of the 10,000 shares of preferred stock which is to be sold for cash; 15,000 shares are to remain in the treasury for sale. The remaining $2,500,000 are to be paid to the underwriters mentioned above for their services in carrying the agreement into effect.

COAL ENERGY TRANSMISSION.—The Harwood Transmission Company, of Hazleton, Pa., has applied for a charter to manufacture electricity and furnish it for the purposes of light, heat and power to the counties of Luzerne, Columbia, Schuylkill, Berks, Lehigh and Northumberland. The principal incorporator of the company is Calvin Pardee, Sr., of Philadelphia. The other stockholders are Alfred Pardee, Ario Pardee, Calvin Pardee, Jr., and A. W. Drake, general superintendent of the Lattimer and Harwood coal mines. These coal operators have conceived the idea of manufacturing electricity at the mines, where fuel is cheap, and then marketing it to all the country for miles around. A big power plant is being erected at Harwood, and lines of wires will reach from the mines to Reading, Allentown, Sunbury, Mauch Chunk, Pottsville, Shamokin, Bloomsburg and all the towns and hamlets in the region. There are millions of tons of coal in the anthracite region that it does not pay to ship to market. It is the size known as "rice," which is so small that there is hardly any sale for it. It is used principally at present at the boiler plants of the coal companies. It contains from 35 to 40 per cent slate, but makes desirable fuel for large plants where no cost of transportation is involved. The projectors of the Harwood Transmission Company are confident that the cost of electricity, taking into account maintenance of poles and wires and interest on the investment, can be considerably reduced by locating the power plants at the mines, thus saving the freight on the coal, and the cost of its handling in the manufacturing centers where it is used now in generating electricity. Of course, several of the lighting and power companies in the coal regions are already doing this thing quite successfully.

STOCKS IN 1906.—The dealings in electrical securities on the New York Stock Exchange and "curb" during the past year were on a very large scale, with wide fluctuations in the prices. On the whole prices flattened out somewhat, affording a ground of safety and solidity for the present time. American Telephone & Telegraph was dealt in to the extent of 10,785 shares reaching 144⅜, falling to 130 and closing at 136, with a decline in the year of 4 points. General Electric was active to the extent of 268,800 shares, ranging through 184 and 156 and closing at 160¼, or 16¾ below the initial quotation. Western Union on 79,497 shares dropped from the high point of 94¼ to 84 as a closer. Westinghouse Electric & Manufacturing on 37,876 shares ranged from 176 down to 148 and closed at 157¾, or 12¼ below the starting point. Allis-Chalmers was one of the most active stocks. The preferred was dealt in to the tune of 1,304,000 shares and from its high point of 67 ranged down to 40, closing at 44½, or 17⅝ below the first quotation. The common stock on 521,600 shares ranged between 27⅜ and 16⅞ and declined 5⅜. Electric Storage Battery on 3,095 shares braced up to the extent of 2¾, closing at 84¾, although its highest point of the year was 87⅛. These prices will fairly indicate the general run of things, and may be taken to evidence a conservatism and a basis for a strong rally.

A NEW STOCK EXCHANGE.—At a meeting of the board of managers of the New York Produce Exchange on the last day of the old year, a recommendation to add trading in stocks to the other business of the exchange was unanimously adopted. A special committee has been appointed to prepare a temporary trading list of about 100 leading mining stocks, and by the middle of this month it is hoped that the innovation will be in full swing on the floor of the exchange. It is understood that the project has the support of many New York Stock Exchange houses. The opposition of that organization to the merger of the Produce Exchange and the Consolidated Stock and Petroleum Exchange, which was proposed a few months ago, does not apply in this case, as no stocks dealt in on the New York Stock Exchange will be included in either the present temporary trading list of mining stocks or in the permanent and carefully selected list of mining, industrial and public service stocks which is to be prepared later. This new stock exchange is intended also to supply a trading centre for first-class traction company stocks of all parts of the United States. It is to be hoped that discrimination will be exercised in selection of both traction and mining stocks, as there are some pretty bad "wild cats" in both categories.

MISSOURI & KANSAS TELEPHONE.—The Missouri & Kansas Telephone Company for the fiscal year ended December 31, 1905, earned less than 1 per cent on its stock, the balance of the 6 per cent rate being paid out of surplus. The increase in gross business in 1906 was $500,000, or over 30 per cent, but the heavy interest charges required to carry the loans to the Missouri & Kansas Company, by the American Telephone & Telegraph Company, have prevented anything more than a nominal increase in surplus earnings. On December 31, 1905, the surplus was equal to about 8 per cent on the stock. It is now not much over 3 per cent. The American Telephone & Telegraph Company has put between $8,000,000 and $9,000,000 into the development of the Missouri & Kansas field. The interest charges on this sum amounts to above $500,000 yearly. At the close of 1905 the company had 54,991 stations of its own and 12,525 sub-licensees. On November 30 last it had 72,135 stations of its own and 18,455 sub-licensees, while 66,000 stations in its territory connect with the lines of the Missouri & Kansas, giving a total of over 150,000 stations.

TELEPHONE STOCK DISPUTE.—A somewhat unusual incident occurred last week in New Jersey. The annual meeting of the New York & Eastern Telegraph & Telephone Company was to have been held in Jersey City, but was enjoined by order of Vice-Chancellor Garrison. Recently the New York & Eastern Company filed a bill in chancery to enjoin the Great Eastern Telephone Company and Edward M. Millard and De Elbert A. Reynolds, from voting 200 shares of its stock on the ground that the stock was fraudulently appropriated and transferred to the defendant. Mr. Reynolds claims that the stock in dispute was purchased by him in the open market and upon motion of his attorneys Vice-Chancellor Garrison has granted an order enjoining F. H. Mildenberg, a director of the New York & Eastern Telegraph & Telephone Company and others from holding the meeting and from transferring any stock pending settlement of the dispute.

PERRY, COFFIN & BURR, 60 State Street, Boston, Mass., have issued a circular listing at attractive prices bond issues of the Schenectady Railway Company, Utica & Mohawk Valley Railway Company, Municipal Gas & Electric Company of Rochester, N. Y.; Brockton & Plymouth Street Railway Company, Indiana Railway Company, Edison Company of Los Angeles, Detroit Edison Company, Birmingham Railway Light & Power Company, Northern Texas Traction Company, Commonwealth Power Company and Grand Rapids-Muskegon Power Company.

MORTGAGE IN ALABAMA.—The Alabama City, Gadsden & Attalla Street Railway Company has filed at Gadsden, Ala., a copy of a mortgage given to the Trust Company of America, New York, for $300,000, which covers the street railway, ice plant and light plant. Improvements costing not less than $150,000 are to be made at once.

GENERAL NEWS.

Construction News.

MONTGOMERY, ALA.—Surveys are now being made by the Montgomery Traction Company for a line from Montgomery to Alexander City.

GADSDEN, ALA.—The Alabama City, Gadsden & Attalla Street Railway Company has now under way improvements which will require an immediate expenditure of $150,000. These include an entirely new electric lighting plant, which will be put in operation very soon. The capacity of the ice plant will be doubled, and franchises have been secured for street railway extensions over several additional streets.

ARGENTA, ARK.—The Argenta Light & Power Company has awarded the contract for construction of its power house to J. H. Leveck, of Little Rock. J. M. Griffin is president of the light and power company.

FT. SMITH, ARK.—Ira L. Reeves, of Muskogee, I. T., president of the United Cities Traction Company, writes that bids will be received about Feb. 15, for the construction of an electric railway about 4½ miles in length, and electric light and power plant to cost in all about $100,000.

BERKELEY, CAL.—The Home Telephone Company has secured a telephone franchise in this city. The price paid for the charter was $47,000.

ANDERSON, CAL.—The Mt. Lassen Power Company plans to begin work early this year on the development of its water-power plant on Battle Creek.

SACRAMENTO, CAL.—The contractors have recommended that an electric lighting plant, to cost $10,000, be installed in the Capitol, which is being remodeled.

REDDING, CAL.—The Northern California Power Company is contemplating the erection of a new plant at the mouth of the Jenny Creek, and surveys for the pipe line will commence soon.

MODESTO, CAL.—Bids will be received by the Board of Supervisors until Jan. 16, for the installing of an electric plant for pumping purposes at the County Hospital. W. J. Marin is clerk.

SAN FRANCISCO, CAL.—George B. Keane, clerk of the Board of Supervisors, writes that the Parkside Transit Company has secured a franchise for a street railway in the Parkside and Sunset districts.

CALISTOGA, CAL.—Arrangements have been made by the Chicago Electric Light Company to increase the capacity of the plant. A new boiler of 600-hp capacity will be installed and other equipment added to the plant.

SAN DIEGO, CAL.—E. Bartlett Webster, president of the East Side Railway Company has petitioned the City Council for a franchise for a street railway line on El Cajon Avenue or University Boulevard from Thirtieth Street to the east line of the city limits.

COMPTON, CAL.—The trustees have offered an electric light franchise for sale, which will be purchased by G. R. Fulton, and as soon as legal forms are complied with the company will commence work on a $22,000 plant which will be in operation within 60 days.

SAN FRANCISCO, CAL.—Announcement has been made that the Pacific States Telephone & Telegraph Company and the Sunset Telephone & Telegraph Company have been merged into one company, and that their various properties and systems, reaching every part of the Pacific Slope, will be taken over by a merger company called the Pacific Telephone & Telegraph Company. The consolidated company has been capitalized at $50,000,000. Many improvements are planned.

REDDING, CAL.—The new power company incorporated as the Pacific Power Company, and which has recently acquired the interests and holdings of the Mt. Lassen Power Company in this county, will not enter the field in competition with the companies now in existence here. The purpose of the new company is to generate power which will be utilized for the raising of the waters of the Sacramento River to a sufficient height to irrigate an immense tract of over 300,000 acres of land in the southern part of the Sacramento Valley. The permanent offices of the Pacific Power Company will be located in Redding. The temporary office is at Red Bluff, where some of the work is now being carried on.

BRANCHVILLE, CONN.—J. E. Schneider has built an addition to his electric lighting plant, located at Little Florida.

LEBANON, CONN.—The Lebanon Street Railway Company has applied to the Legislature for permission to construct an electric line through the towns of Lebanon, Andover and Bolton and to a connection with the existing lines in the town of Manchester.

THOMASTON, CONN.—The Thomaston & Watertown Electric Railway Company has applied to the General Assembly for permission to construct an electric railway from Watertown to Terryville and for an extension of time for the construction of its lines.

CHESTER, CONN.—A petition will be presented to the next Legislature by the Shore Line Electric Railway Company for the right to build an extension to the lines allowed by the present charter. The extension to be asked for is six miles in length and will run from Essex to Chester through Deep River.

WATERBURY, CONN.—D. W. Cooley, of this place, has taken an option of the land at the palisades, situated about two miles from Waterbury, on the Winooski River, and also has options on other property in that vicinity. Surveys are now being made and it is estimated that an electric plant can be installed which will develop 1,000 hp.

RIDGEFIELD, CONN.—The Ridgefield Electric Company will apply to the Legislature for an amendment of charter, extending its privileges for electric lighting purposes and also the right to manufacture and deal in artificial ice. The company has erected an electric lighting plant and states that it is prepared to furnish electricity for lighting in the borough of Ridgefield, but it claims that it is unable to do so on account of the present restriction as to the highways it is empowered to use.

BERLIN, CONN.—Work has commenced on the changes to be made at the power house at Berlin Junction. The voltage is to be changed from 13,000 to 11,000. The Berlin station is now furnishing electricity for operating the Parkville and West Hartford electric lines of the Consolidated Railway Company. Electric energy for the Farmington Street Railway Company is also to be furnished from this station, and the company is now engaged in installing a feed line from Plainville to Farmington. Electricity is to be carried from Berlin to Plainville over the old third rail high tension wire system.

WILMINGTON, DEL.—The street and sewer directors, Jan. 1, passed the franchise for the Delaware Electric Transmission Company over the veto of Mayor Wilson. It was originally granted to the Commercial Light, Heat & Power Company, but was recently divided, so that the Commercial Company held a right to use the streets for gas pipes and a new company was formed to supply electricity.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 22, to furnish at the navy yards, etc., Portsmouth, N. H., Boston, Mass., Newport, R. I., New York, N. Y., League Island, Pa., Washington, D. C., and Norfolk, Va., a quantity of supplies, as follows: Schedule 345—vitrified conduit, metal plugs, electric wires and cables, piles, steel beams, asphaltum, etc. Schedule 349—incandescent lamps, commutator, spark plugs, dash coils, batteries, etc. Bids will also be received until Feb. 5, at the navy yards, Mare Island, Cal., and Puget Sound, Wash., for a quantity of naval supplies, as follows: Schedule 356—brass, rolled bronze, sheet copper, brass and copper pipe, etc.; also until Feb. 5, to furnish at the navy yards, etc., Boston, Mass., New York, N. Y., Charleston, S. C., Mare Island, Cal., and Frenchman's Bay, East Lamoine, Me., a quantity of machine tools, as follows: Schedule 352—electric traveling cranes, etc. Schedule 353—side-crank steam engine. Schedule 354—horizontal steam steering engines, radial drilling and countersinking machine. Applications for proposals should designate the schedules by number. E. B. Rogers, Paymaster General, U. S. A.

JACKSONVILLE, FLA.—Bids are about to be asked by the Board of Bond Trustees for the purchase of two new boilers for the electric light plant. R. N. Ellis is superintendent.

JACKSONVILLE, FLA.—The contract for the illumination and power plant for Dixieland, an amusement resort, has been awarded to the Florida Electric Company. The lighting scheme calls for 20,000 incandescent lamps and a motor service for roller coaster, circular swings, etc.

BRUNSWICK, GA.—F. D. M. Strachan is interested in a project to obtain control of the Mutual Light & Water Company and to secure a franchise for the construction of an electric street railway.

CHICAGO, ILL.—Edward B. Ellicott, electrical engineer American Trust Building, writes that bids will be opened on Feb. 20 for the construction of transmission lines for the Sanitary District of Chicago. The probable cost of work is placed at $15,000.

PEORIA, ILL.—Sealed proposals will be received at the office of the Commissioner of Public Works until Jan. 21 for furnishing the city with not less than 770 electric street lamps. E. A. Furry is commissioner of public works.

SPRINGFIELD, ILL.—Application will soon be made to the City Council for a franchise for a new electric light company which will compete with the Springfield Electric Light & Power Company. The new company is to be organized by local business men with a capital stock of $250,000.

BROOKVILLE, IND.—The City Council has decided to construct a municipal lighting plant.

ALBION, IND.—The Noble County Telephone Company is said to be in the market for a new switchboard.

MONTICELLO, IND.—The switchboard of the Monticello Telephone Company was entirely burned out on Jan. 4.

RICHMOND, IND.—The Richmond Home Telephone Company has increased its capital stock from $150,000 to $400,000.

RICHMOND, IND.—A lighting plant, composed of an engine, dynamo and their accessories, is for sale by the county. This plant is located in the basement of the county jail. The plant was installed when the court house was built, at a cost of $5,000, and is now in good condition. It has a maximum capacity for 600 lamps.

EVANSVILLE, IND.—The Citizens Telephone Company will again apply for a franchise in this city. The Cumberland Company has announced that it will not fight the franchise of the independent company. The promoters of the Citizens Company say they will begin at once to construct a $600,000 plant if the franchise is granted.

PERU, IND.—The City Council has rejected the proposition of the local electric light company for the purchase of the plant. The members of the Council, notwithstanding a considerable sentiment in favor, are opposed to municipal ownership and announced that the City Council stands ready to grant a franchise to any responsible company to light the city and sell electricity for light, heat and power. The contract with the local company has expired.

TULSA, I. T.—The Pioneer Telegraph & Telephone Company contemplates an expenditure of $250,000 in improvements in the Tulsa oil fields within the next 12 months. The company will expend $25,000 in the Tulsa system, which will be the headquarters of the company. E. D. Nims is president.

EDEN, IA.—The Eden Mutual Telephone Company has been incorporated with a capital stock of $5,000.

DUBUQUE, IA.—Surveys are being made for the proposed electric line, which is being promoted by W. D. Onley.

WATERLOO, IA.—The Waterloo, Cedar Falls & Northern Railway Company is contemplating the construction of a new power house at a cost of $100,000.

CENTERVILLE, IA.—The power plant of the Centerville Light & Traction Company was not destroyed by an explosion as reported in our issue of Dec. 22. The explosion occurred in the gas plant which is in the same building with the electric plant. James Frady is not now chief engineer, having severed his connection with the company in November.

LOUISVILLE, KY.—The White City Electric Light, Heat & Power Company has filed amendments to its charter changing its name to the Jefferson County Electric Company and reducing the capital stock from $300,000 to $75,000.

HOPKINSVILLE, KY.—The City Light Company, of Hopkinsville, is soon to add to its electrical equipment two Allis-Chalmers generators and exciters. The generators have a capacity of 175 and 250 kw respectively, with exciters of 6 and 9 kw.

LOUISVILLE, KY.—The Kentucky Electric Company has acquired a site on Third Avenue and Water Street on which it will erect its power house. Contracts for machinery for the power plant will be let at once and work on the construction of the plant will commence very soon. Donald McDonald is president of the company.

LAKE CHARLES, LA.—At the annual meeting of the Lake Charles Ice, Light & Water Works Company, the directors voted to increase the capital stock from $100,000 to $150,000. The capital stock of the Lake Charles Street Railway Company was increased from $15,000 to $50,000.

NEWPORT, ME.—The Newport Electric Light & Power Company is installing the new street lighting system recently contracted for by the village. The plan is to place incandescent lamps of 32 cp throughout the village leaving several arc lamps on Main Street, substituting the arcs for incandescents elsewhere.

BELFAST, ME.—A petition has been signed by the representative men of Belfast asking the Legislature to grant to William H. Quimby, James H. Howes, Charles H. Field and George A. Quimby the right to incorporate under the name of the Citizens' Electric Company for the purpose of generating and distributing electricity and gas for heating, lighting and power purposes in the city of Belfast.

HAGERSTOWN, MD.—The Hagerstown & Northern Railway Company will soon install two 150-hp generators in its power plant. When these machines are placed the plant will have a capacity of 1,000 hp.

MANSFIELD, MASS.—A new engine is being installed in the municipal electric lighting plant.

SPRINGFIELD, MASS.—The United Electric Light Company is considering plans for enlarging its steam plant.

WINCHESTER, MASS.—The entire municipal electric light system is being entirely renovated under the supervision of E. A. Johnson, town electrician.

ORANGE, MASS.—The Orange Electric Light Company is preparing to furnish a day service for lighting and power, and hopes to be able to establish the service next month.

WORCESTER, MASS.—The Benoit Transmitting Power Company has been chartered with a capital stock of $100,000. Eli Benoit is president and Napoleon Oliver treasurer of the company.

FALMOUTH, MASS.—E. S. Webster, a member of the firm of Stone & Webster, of Boston, a summer resident of the town, residing at Quissett, will install an electric light plant to light several private residences in that vicinity.

WORCESTER, MASS.—The Worcester Electric Light Company has reduced the price of electrical energy for incandescent lamps used by the city from 8 cents to 6 cents per kw-hour. The rate applies to lamps for all municipal buildings.

BOSTON, MASS.—By a vote of 11 to 2 the Board of Aldermen passed over the Mayor's veto an order granting a franchise to the Metropolitan Home Telephone Company, an independent organization, which is seeking to do business in Boston.

LEOMINSTER, MASS.—The Massachusetts Lighting Company, which controls the Leominster Electric Light & Power Company, and lighting plants in several other towns and cities in Massachusetts, is planning to take over the Electric Light Company, of Ayer, in the spring.

MARBLEHEAD, MASS.—Arrangements have been practically completed by the Electric Light Department for establishing a day service in the town. Two motors have already been installed by different parties and several others are contemplating using electricity for operating their works.

FORT WARREN, MASS.—Bids will be received until Jan. 21 by Captain George L. Goodale, constructing quartermaster, U. S. A., 263 Sumner Street, Boston, for furnishing and installing electric light fixtures, watt-hour meters, and making service connections in the new hospital at Fort Warren.

FORT BANKS, MASS.—Bids will be received until Jan. 21 by Captain George L. Goodale, constructing quartermaster, U. S. A., 263 Sumner Street, Boston, for furnishing and installing electric light fixtures, watt-hour meters, and making service connections in the new post exchange and gymnasium and N. C. S. O. Quarters, Fort Banks.

HOUSATONIC, MASS.—The new power plant of the Monument Mills Company, at Glendale, has been completed and will supply electricity to operate the mills of the company at this place. The plant is the largest one on the Housatonic River in Massachusetts and can furnish 3,000 hp. The present capacity of the plant is 750 hp.

GROVELAND, MASS.—This town has voted in favor of public ownership of the lighting plant. At a special town meeting held recently the citizens voted to purchase the equipment of the Haverhill Electric Company in the town, which consists of poles and wires for the maintenance of about 100 incandescent lamps. The town has been without street lights, except such kerosene equipment as the Village Improvement Society has maintained, for the year past, the Haverhill Electric Company's contract having been allowed to run out. The town may buy electricity of the company and postpone the building of a power plant until the question of a water supply can be settled.

HOLYOKE, MASS.—The annual report of the Holyoke gas and electric lighting department was filed Jan. 1. The report shows a continuation of the highly pleasing conditions which have already made the department the most successfully administered in New England and one of the most prosperous in the country. Besides the reduction made Dec. 1 in gas to $1 per 1,000 cubic feet, net, further reductions are announced. The price of arc lamps is reduced from $80 per lamp per year to $60, while a price of 10 cents per kw-hour for incandescent lamps is announced. In addition, the department will hereafter supply renewal of lamps free of charge and betweeen now and May 1 will change the present 56-watt lamp to 45-watt lamp. At the electric station a 1,000-kw turbo-generator has been installed and three boilers have been contracted for. These will give the station a rated steam capacity of 3,000 hp, and a possible maximum of 4,000 hp.

ESCANABA, MICH.—O. L. Huie, of Marinettee, Wis., is reported to have made a proposition for an electric light and gas system here.

KALAMAZOO, MICH.—The Commonwealth Power Company has decided to build a dam at Kalamazoo to provide additional power. J. B. Foote, of Jackson, Mich., is manager.

KALAMAZOO, MICH.—The Michigan United Railways Company is contemplating improvements to its system in Kalamazoo and vicinity this year, which will involve an expenditure of $150,000. The greater part of the expense will be incurred in track extensions.

FAIRMONT, MINN.—Bids will be received until Jan. 15 by H. P. Edwards, county auditor, Fairmont, for electric fixtures for the Martin county court house at Fairmont.

MINNEAPOLIS, MINN.—The Minneapolis & St. Paul Suburban Railway company is contemplating the extension of its Excelsior line to Birch Bluff, and will build a spur line of one mile to Tonka Bay.

ST. PAUL, MINN.—Mayor Smith has signed the ordinance granting a franchise to the Northern Heating & Electric Company, to use the streets and alleys for conduits, poles and wires, for electric lighting and power purposes.

SARCOXIE, MO.—The Sarcoxie Electric Light & Milling Company has increased its capital stock from $7,500 to $16,500.

CORSICANA, MO.—The Corsicana Telephone Company has filed an amendment to its charter increasing its capital stock from $50,000 to $100,000.

HELENA, MONT.—The new power plant of the Helena Power Transmission Company will be in operation about Feb. 1. The plant is located on the Missouri River, about 20 miles from Helena, and will have a capacity of 10,000 hp, which has all been contracted for in Butte, more than 100 miles distant. The transmission line is completed and every thing done but to close the gap in the dam and allow the lake to fill, which will take more than two weeks.

VALPARAISO, NEB.—A franchise has been granted to D. M. Dean for the establishment of a lighting plant.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company is said to be contemplating running a cable across the river direct from the power house to Lake Manawa, connecting with the substation which the company expects to build at the lake before the opening of the next season.

CARDENAS, N. C.—The Cardenas Telephone Company has been organized and the following officers elected. Dr. J. M. Judd, of Cardenas, president; A. C. Burt, of Holly Springs, vice-president; E. H. Ballentine, of Walthal, secretary, treasurer and business manager. The company begins with a capital stock of $975.

HAMLET, N. C.—C. Gresham and J. A. Williams, of Charlotte, have purchased the electric light plant in this town. The plant will be enlarged.

ROANOKE RAPIDS, N. C.—J. T. Wilson, of Richmond, Va., is constructing the power plant here for the Roanoke Rapids Power Company, to cost about $100,000. H. C. Cooper is general manager.

DURHAM, N. C.—A plan is being considered for the establishing of a belt line electric railway around the town, to supplement the service of the Durham Traction Company. The new line will be about four miles in length.

CLAREMONT, N. H.—The Black River Electric Power & Lighting Company is preparing to develop the water power of Black River. The company has purchased the water power at Cavendish Gorge, Vt., and acquired control of Patch Pond in Mt. Holly, and is arranging to control Rescue Lake in Ludlow and Amherst pond in Plymouth, to be used for storage purposes. The main generating station will be erected at Cavendish. This plant will be equipped with three turbine water wheels having a capacity of 2,000 hp., for which, it is stated, that a large portion has been contracted for by Claremont manufacturers. Locations for the power plant are now being surveyed, and work on the construction will be commenced within a few weeks. The officers of the company are: John B. Reynolds, of New York, N. Y., president; J. E. Jones, of Boston, Mass., treasurer; L. N. Wheelock, of Claremont, general manager.

ASBURY PARK, N. J.—Mayor Chas. A. Atkins in his annual message recommended the construction of an electric light plant.

MORRISTOWN, N. J.—The Public Service Corporation has decided to reduce the price of electricity from 15 cents to 12 cents per kw-hour.

NEWARK, N. J.—The question of the adoption by the city of a municipal electric lighting plant is to be submitted to the people at the next general election, according to the recommendation submitted to the Common Council Jan. 3 by the special committee that has had charge of the investigation of this question for several months past.

JERSEY CITY, N. J.—The Morgan Street sub-station of the General Electric Company of New Jersey is now in full operation and is receiving electric energy from the Marion Street plant, which has recently been rebuilt. The company is now prepared to give an improved and enlarged service to its electric light and power consumers. A new turbo-generator set of 3,000-kw capacity has recently been installed in the Marion Street power house.

PLAINFIELD, N. J.—The Jersey Central Traction Company has offered Middlesex County $50,000 for a 20-year franchise to construct an electric line across the drawbridge between Perth Amboy and South Amboy, to connect with its shore line, which is now separated by the Raritan River. The company also offers to build an electric line to connect Plainfield and South Plainfield with seashore points. Surveyors are now making a preliminary line from Amboy to Plainfield.

OLEAN, N. Y.—The Mayor in his annual message is stated to have recommended the lighting of the streets by the city.

FORT PLAIN, N. Y.—The Village Trustees have granted the Hudson River Electric Power Company a franchise for the erection of poles, wires, etc., for the transmission of electricity through the village.

BALLSTON SPA, N. Y.—The Eastern New York Railway Company contemplates extending its lines through Saratoga County, touching Galway, North Galway and Hagaman's, and will also build a branch to Amsterdam.

JAMAICA, L. I., N. Y.—Bids will be received until Jan. 14 by C. B. J. Snyder, superintendent of school buildings, New York City, for alterations to electric equipment of Jamaica Training School, Borough of Queens.

PALATINE BRIDGE, N. Y.—The Board of Trustees have placed a contract with the Montgomery Electric Light & Power Company, of Canajoharie for lighting the streets of the village for a term of five years. The contract calls for arc lamps at $50 per lamp per year. Under the old contract with the same company the village paid $70 per lamp. W. J. Roser, of this village, is president and manager of the company.

SCHENECTADY, N. Y.—The Common Council on Dec. 26 voted to direct the Board of Contract and Supply to enter into a contract with the Schenectady Illuminating Company for lighting the streets of the city for a term of three years in accordance with a schedule submitted by the company. The company agrees to furnish arc lamps at $67.50 per year. The city is now paying $82 per lamp per year. The new contract will mean a saving of between $10,000 and $11,000 to the city, using the same number of lamps as at present. According to the contract the company agrees to furnish arc lamps at $60 per lamp after the city has 700 lamps in use.

SCHENECTADY, N. Y.—The Schenectady Illuminating Company has made a substantial reduction in rates for electricity which took effect on Jan. 1. The reduction places the maximum charges at 12 cents a kw-hour instead of 15 cents, with a minimum price of 7 cents. Then in addition the discount has been increased from 10 per cent to 16⅔ per cent if the bills are paid within 15 days from date of bill. The new power rates will be as follows: A sliding scale from 7 cents to 3¼ cents per kw-hour, depending upon the amount consumed. A cash discount of 10 per cent will be allowed for the payment of power bills within 15 days after the date of bill. The minimum charges on the lighting installations will remain the same as heretofore. The minimum charges under the power rate will be $1 per month on installations of 1 and 2-hp capacity. On installations above 2 hp the minimum charge will be 50 cents per hp. per month.

DELPHOS, OHIO.—A number of business men are considering a proposition of installing an electric light plant in this city.

BRYAN, OHIO.—The proposition to issue $40,000 bonds for the improvement of the lighting and water plant here was defeated at a special election held Jan. 3.

CLEVELAND, OHIO.—The City Council has passed an ordinance granting the Low Fare Railway Company the right to use the streets from East Fourteenth Street to the West Side.

YOUNGSTOWN, OHIO.—It is reported that all of the properties of the Mahoning & Shenango Valley Railway & Light Company will be sold in a short time to the Everett syndicate of Cleveland. The sale includes all the electric lines in Youngstown, Warren, Sharon and Newcastle, and the gas and electric light franchises in this city, Newcastle and Sharon, and the water-works plant in the last named place. The capital stock of the company is $10,000,000.

CLEVELAND, OHIO.—A contract has been made with the Cleveland Electric Illuminating Company for arc lamps used on the streets at the rate of $67.92 each for the coming year. This is $1.80 per lamp less than last year. At present the company is operating 1,350 lamps for the city. President Springborn of the Board of Public Service states that the plans for lighting the West Side from the Brooklyn municipal plant will be proceeded with, notwithstanding the low bid of the company. He also states that the report of the municipal plant this year will show that the lighting can be done at a cost of $60 per lamp per year.

PRINEVILLE, ORE.—L. B. Lafolett, secretary Pringle Falls Electric Power & Water Company, writes that bids will probably be received in May or June for the construction of the plant, to cost about $200,000. W. H. Huston is engineer.

SUMPTER, ORE.—Manager John Thomsen, of the Fremont Power Company and Red Boy mine in the Granite Camp, 30 miles west of Baker City, states that the pipe line to the power house has been completed and transmission lines from the power house to the Red Boy, Granite and other mines are being erected. When completed the plant will not only operate the Red Boy mine, but will furnish electricity for lighting and power to many camps and towns and may even enter Baker City.

GREENSBURG, PA.—The West Penn Street Railway Company is said to be contemplating the extension of its lines from Greensburg to Saltsburg via Crabtree and New Alexandria.

PHILADELPHIA, PA.—Bids will be received until Feb. 9 by Mordecai G. Endicott, chief bureau yards and docks, navy department, Washington, D. C., for furnishing one generator set for the navy yard, League Island, as per specification No. 1524. The estimated cost of the apparatus is $3,750.

CHESTER, PA.—A charter has been granted for the extension of the Philadelphia Rapid Transit Company's electric line from Darby to 60th and Market Streets, Philadelphia, going through Lansdowne and Cardington. The company will ask the Council of Lansdowne for franchises on certain streets.

NANTICOKE, PA.—C. L. Fairchild, borough secretary, writes that the contract for lighting the streets for three years has been awarded to the Wyoming Valley Gas & Electric Company, of Plymouth, at $60 per lamp per year for arc lamps and $20 per lamp per year for incandescents of 25 cp.

EASTON, PA.—Sixty of the leading men and business firms of Easton, Pa., have petitioned the Select Council, urging the Council to advertise for bids for lighting the streets of the city and for bids to keep the city's lighting plant in operation and repair while a private corporation is preparing to light the city. This action is the outcome of the failure of the service given by the municipal plant, which is run at a loss of from $4,000 to $5,000 a year.

SOUTH KENSINGTON, R. I.—The Town Council has granted a franchise to the Sea View Railroad to construct an electric railway on certain streets in the town.

SENECA, S. C.—It is stated that bids will be received until Feb. 2 by the Board of Public Works for $30,000 water and electric light bonds.

SIOUX FALLS, S. D.—F. M. Mills, of Benton Harbor, Mich., is considering the proposition of constructing an electric railway in this place.

KNOXVILLE, TENN.—The Knoxville Railway & Light Company is now installing additional arc lamps under its new contract with the city. The contract calls for 22 arc lamps and 80 incandescent lamps.

NASHVILLE, TENN.—The Cumberland Telephone & Telegraph Company has increased its capital stock from $17,000,000 to $20,000,000. The proceeds of the new issue will be used for extensions and betterments in Kentucky, Tennessee, Mississippi and Louisiana and the conduit system in Nashville.

NASHVILLE, TENN.—Work on the electric power plant to be erected at Caney Fork Falls by C. H. Fisk and C. W. Post, of Michigan, which will call for the expenditure of $3,000,000, has been begun, and will be completed as soon as possible. The plant is to supply electricity to manufacturing establishments in Nashville and Chattanooga, and includes the construction and operation of an electric railway, to connect Chattanooga with Nashville. The distance between them by steam railroad is 151 miles, and it is intended to reduce the distance by the new line, which will cover only 98 miles. Pittsburg capitalists, it is understood, will finance the railroad, and Messrs. Fisk and Post will control the power plant.

HENRIETTA, TEX.—The electric light plant at this place, owned by the Henrietta Light & Power Company, was destroyed by fire on Dec. 28.

FORT WORTH, TEX.—A petition is being circulated by the Fort Worth Light & Power Company, asking the City Council for an extension of its present franchise for a period of 25 years. The franchise of the company will expire within the next six years and application for an extension will be presented to the Council during the early part of next year. According to the application the city has the power to regulate the cost of light and gas to the consumers after Nov. 15, 1915.

SALT LAKE CITY, UTAH.—The County Commissioners have granted Judge Le Grand Young a franchise for the construction of an electric railway up Emigration Canyon to his rock quarries in Burr's Fork. The term of the franchise is for 50 years.

BENNINGTON, VT.—It is reported that the Wilmington & Whitingham Traction Company, which contemplates building an electric railway from Halifax on the Massachusetts line to Wilmington, will eventually extend its line to Bennington, which will require building an additional 17 miles. It is said that the new owners of the Shelburne Falls & Colerain Street Railway will extend that line the coming summer to Wilmington, a distance of 20 miles.

STARBUCK, WASH.—Dr. Pietrzycki has been making surveys for an electric light plant.

SPOKANE, WASH.—It is announced that the Lucky Calumet Mining Company, which is now installing an electric plant furnished by the General Electric Company, to utilize the electric energy furnished by the Washington Power Company, will also furnish electricity to operate several properties in the vicinity of its own mines.

EAU CLAIRE, WIS.—The Northwestern Lumber Company is reported to have decided to expend $90,000 for a power plant, to furnish electricity in Eau Claire.

MILWAUKEE, WIS.—The Bliss Electric Car Lighting Company has increased its capital stock from $100,000 to $1,500,000. William L. Bliss is president.

NEW WESTMINSTER, B. C.—Work will be commenced shortly by the British Columbia Electric Street Railroad Company on a line from here to Eburne. R. H. Sperling is general manager.

LADNER, B. C.—The town is now lighted by electricity from a temporatory plant which has been installed by the British Columbia Electric Railway Company. The Ladner people have offered to effect a compromise with the railway company in regard to the proposed railway project.

EDMONTON, B. C.—The Public Works Department of Alberta Government is making arrangements for the construction of a public telephone line between Edmonton and Lloydminster. Work will also be commenced shortly on the construction of another line running north from Edmonton to Athabasca Landing.

EDMONTON, CAN.—The City Council has purchased 20,000 feet of bituminized fibre conduit for underground wiring, 86,000 feet of telephone cable will be ordered within a few days. Address Mayor Griesbach.

EDMONTON, CAN.—It is proposed to install at the electric light plant a 1,000-kw, three-phase, 60-cycle, 2,400-volt turbo-generator set (steam) auxiliaries. R. R. Kelly is city engineer.

LETHBRIDGE, ALB., CAN.—Application is being made to incorporate the Lethbridge Radial Railroad Company to build electric railways in and around this town.

PRINCE ALBERT, CAN.—C. O. Davidson, city clerk, writes that no bids have yet been asked for constructing the proposed water works and electric light plant, and will not be before spring.

STRATHCONA, CAN.—The City Council has granted the Edmonton City Council a fifteen-year franchise to extend its automatic telephone system across the river to this town and to operate a telephone system here. Address Mayor Davidson.

STONEWALL, MAN.—The Town Council is considering the installation of an electric lighting plant. Address Ira Stratton.

PORTAGE LA PRAIRIE, MAN.—The town has practically decided to take over and operate the electric light plant. Address E. Brown, mayor.

WINNIPEG, MAN.—Tenders will be received by the chairman of the fire, water and light committee until Jan. 14 for a 750-kw electric generating plant. Specifications and form of tender may be obtained from H. N. Ruttan, city engineer.

MILLBROOK, ONT.—The Council is considering the installation of an electric lighting system.

TORONTO, ONT.—It is stated that the Huron & Ontario Electric Railway Company will build a line from the Georgian Bay to Lake Ontario, with terminals at Toronto and Whitby.

TORONTO, ONT.—The Stark Telephone, Light & Power Company has purchased the property and franchises of the Southern Light & Power Company at Erindale, for $47,500.

ST. THOMAS, ONT.—The light, heat and power department has made a good showing under municipal ownership. After reserving $5,000 for contingencies $12,000 has been paid into the city treasury.

ST. THOMAS, ONT.—The ratepayers of St. Thomas will vote on the by-law empowering the Council to negotiate with the Hydro-Electric Power Commission for the delivery of Niagara power in St. Thomas.

TORONTO, ONT.—The citizens on Jan. 1 voted in favor of empowering the City Council to make a contract with the Hydro-Electric Commission for a supply of electricity for the consumers of this city.

HAMILTON, ONT.—The City Council has decided to submit a by-law to the people authorizing the next year's council to enter into an agreement with the Hydro-Electric Power Company to supply electricity, the cost for 15,000 hp being from $13.97 to $16.25, and for less than that at from $14 to $17.50.

FORT WILLIAM, ONT.—Although the citizens of Fort William pay only $2 a month for business telephones and $12 a year for residence, the city during 1906 realized a profit on its municipal telephone plant of $3,300, after providing for a sinking fund and interest, and ten per cent of the gross receipts for depreciation in value of plant. The profits of the electric light department amounted to about $1,000, the gross receipts being $34,000.

MONTREAL, QUE.—The Bell Telephone Company has submitted a proposition to the City Council offering to place all its wires underground in the city.

MONTREAL, QUE.—The Merchants' Light, Heat & Power Company has been chartered for the purpose of manufacturing and furnishing light and power. R. R. Du Tremblay is attorney.

MONTREAL, QUE.—It is stated that financial arrangements have been made for the building of the Ottawa Valley Electric Railroad which will run from Montreal to the Great Lakes. Tenders for construction will be called shortly.

BOULEVARD ST. PAUL, QUE.—The Council has awarded the contract for lighting the streets to L. J. Marchand. The contract is for 40 lamps at $75 per lamp per year and runs for a term of 30 years, and when 75 lamps are used the price will be reduced to $72 per lamp and when 100 or more lamps are in use the price will be reduced to $70 per lamp. Mr. Marchand has the privilege of supplying the electricity for lighting to residents at the rate of one cent per ampere-hour, for each 16-cp lamp.

MONTREAL, QUE.—The Canadian Light, Heat & Power Company has applied to the City Council for permission to furnish electricity for light and power in the city and for an opportunity to compete for the city lighting contract. The company has a capital stock of $4,000,000, and is to develop what is known as the Beauharnois Canal. The following men are interested in the project: F. Howard Wilson, William Cassils McIntyre, William C. Finley, E. A. Robert, George G. Foster, S. H. Ewing, H. J. Fuller, P. J. McIntosh, F. J. Shaw and William Lyall.

MONTREAL, QUE.—The City Council on Dec. 27 passed an ordinance authorizing the city to build, operate and maintain a system of underground conduits where all the telegraph, telephone and electric lighting wires and other wires or cables and transmission lines belonging to persons or companies shall be placed. The ordinance also gave the city power to order all companies to bury their wires. The city is to have the right to charge a rental upon all persons or corporations using space in the said conduit system, in order to cover the cost of maintenance. The Council authorized the issue of bonds not exceeding $1,500,000 for the construction of the system.

MAZATLAN, MEX.—J. C. Dillert, of San Francisco, has been investigating the situation at Mazatlan with the view of constructing a system of electric street railways.

PARRAL, MEX.—A company of Mexican capitalists has been formed for the purpose of constructing a system of electric railways in Parral. The company has a capital stock of $110,000. Rodolfo Valles is president.

TAMPICO, MEX.—E. C. Breton, president of the Tampico Street Railway system is preparing to convert the mule car lines into electric and to extend the system to the beach, six miles distant. He is also negotiating for the purchase of the electric light plant at Tampico.

SAN LUIS POSTOSI, MEX.—The street railway system in San Luis Potosi has been sold to Jose Dominguez for $250,000. Mr. Dominguez will extend the system and will convert it from mule to electric transit. It is reported that he will expend several hundred thousand dollars in making these improvements.

TORREON, MEX.—The electric street railway system of Torreon and the interurban electric railway which runs between Torreon and Lerdo, have been purchased by the Torreon & Lerdo Electric Tramways Company. The system is to be extended and otherwise improved by the new company which has increased its capital stock $100,000 for the purpose.

Company Elections.

WINDSOR LOCKS, CONN.—At a recent meeting of the North Connecticut Light & Power Company the following officers were elected: Parker H. Kemble, president; Harrison B. Freeman, secretary; Burdette Loomis, treasurer. Mr. Kemble will continue as general manager.

MONSON, MASS.—At the annual meeting of the stockholders of the Central Massachusetts Electric Company, held recently, the following officers were elected: C. B. Fiske, treasurer; F. N. Carpenter, clerk, and the directors are Charles E. Fish, Charles B. Fiske, George C. Flynt, George E. Fuller, W. H. Fairbanks, H. L. Merry, A. W. Paige and M. J. Warner.

ESSEX, N. Y.—At the annual meeting of the Boquet Electric Power Company, held recently, the following directors were elected: J. B. Burnham, S. M. Mason, E. L. Mason, of Essex; W. S. Stratton, of Wadhams, N. Y.; F. W. Barber, of Elizabethtown. Later the board elected J. B. Burnham president, S. M. Mason vice-president, E. L. Mason, secretary and treasurer.

New Industrial Companies.

THE CITIZEN'S ELECTRICAL COMPANY, of Charleston, S. C., has been chartered with a capital stock of $7,000 by D. S. Lewis and H. M. Franks.

THE J. A. MEBANE COMPANY, of South Boston, Va., has been incorporated with a capital stock of $2,500 for the purpose of manufacturing, selling and dealing in electrical supplies, etc.

THE ELECTRIC RAILWAY EXPRESS COMPANY, of Macon, Ga., has been incorporated with a capital stock of $10,000. The company proposes to operate an express business throughout the United States.

THE PITTSBURG MICA COMPANY, of Pittsburg, Pa., has been incorporated, with a capital stock of $60,000, for the purpose of acquiring and developing mines and mining rights, especially mica and talc.

THE LOZIER GAS ENGINE COMPANY, of Buffalo, N. Y., has been incorporated, with a capital stock of $50,000. The directors are A. A. and L. W. Lozier, of Buffalo, and J. N. Williams, of New York.

THE SCOTT ELECTRICAL COMPANY, of Augusta, Me., has been organized for the purpose of conducting a general electrical business with a capital stock of $500,000. The officers are M. M. Spinney, of Augusta, and E. J. Pike, treasurer.

THE ELECTRIC FURNACE COMPANY, of Portland, Me., has been organized for the purpose of dealing in electrical machinery and appliances. The capital stock is $500,000. The officers are James E. Manter, of Portland, president, and Charles D. Fuller, treasurer.

THE IDEAL SWITCH COMPANY, of New Britain, Conn., has been incorporated with a capital stock of $2,500. The purpose of the company is to make and deal in articles that may be used in the transmission and control of electricity. The incorporators are Barbara Hoerle, Frederick Hoerle and Clayton J. Foster.

THE JONES-BEACH & COMPANY, of New York, N. Y., has been incorporated to manufacture gas and electrical supplies. The company has a capital stock of $50,000, and the directors are E. M. Jones and Ludwig, of New York, and A. F. Beach, of West Orange, N. J.

THE ROYAL PHONE & RECORD MANUFACTURING COMPANY, of Portland, Me., has been incorporated, with a capital stock of $1,000,000, for the purpose of manufacturing and dealing in talking machines. C. E. Perkins is president and T. H. Gately, Jr., treasurer, all of Portland.

THE AMERICAN GAS & ELECTRIC COMPANY, of New York, N. Y., has been incorporated with a capital stock of $7,000,000 to manufacture apparatus for storing and disposing of gas and electricity. The directors are H. L. Doherty and W. H. Pitkin, Jr., of New York, and M. C. Hunstone, of Brooklyn.

THE ELECTRIC GAS COMPANY OF AMERICA has been incorporated with a capital stock of $3,000,000. The officers of the company are John P. Harbison, of Hartford; Joseph F. Tuttle, of Hartford, vice-president and counsel; Daniel N. Morgan, of Bridgeport, treasurer; Frederic G. Perine, of Boston, Mass., secretary. The purpose of the company is to sell machinery for the manufacture of gas under patents, which are for the manufacture of carborated hydrogen or water gas, with electric heat as a substitute for heat obtained from coal, coke or other substances. The office of the company will be in Hartford.

New Incorporations.

FORT PAYNE, ALA.—The Alabama Railway & Power Company has been incorporated with $100,000 capital stock. This company proposes to run a road from Chattanooga to Birmingham. H. T. Henderson, of Durango, Col., is among those who are interested in the project.

EUREKA SPRINGS, ARK.—The Ozark Bell Telephone Company has filed articles of incorporation with a capital stock of $25,000. G. M. Sebree is president.

COLUSA, CAL.—The Colusa County Telephone Company has filed articles of incorporation and elected the following officers: C. L. Schaad, president; W. T. Rathburn, vice-president; J. Morris Jones, secretary; Bank of Williams, treasurer.

BADITO, COL.—The Badito Reservoir, Irrigation & Land Company has been incorporated by P. J. Lesser, Joseph Blair and I. N. Blair and others, to build reservoirs for the purpose of irrigating lands in Huerfano, Pueblo, Otero and Las Animas counties; capital, $8,000,000. The water is to be taken from the watershed of Huerfano River in the western part of Huerfano County. Besides irrigation, water will be used for power and manufacturing purposes in mines and mills. The offices and the principal place of business will be in Denver.

HARTFORD, CONN.—Articles of incorporation have been filed with the Secretary of State for the Plainfield & Sterling Railway Company by H. H. Gallup and others. The company proposes to construct an electric railway from Moosup to Sterling.

NEWTOWN, CONN.—The Newtown Street Railway Company has filed articles of incorporation with the Secretary of State for the purpose of constructing and operating an electric street railway in the towns of Newtown, Bethel, Danbury, Southbury and Woodbury. The incorporators are T. H. McKenzie, of Southington; M. J. Houlihan, W. A. Leonard and A. J. Smith, of Newtown.

NEW CANAAN, CONN.—The New Canaan Street Railway Company has been incorporated by William Wardwell, John B. Bliss, Charles B. Keeler, Frederick A. Palmer, Junius Benedict, C. N. Scoville, J. F. Silliman and T. Rogers, all of New Canaan; Lester Hyatt, Frank H. Merrill, Reed G. Haviland and W. F. Acton, of Norwalk. The company proposes to construct an electric railway from Norwalk to New Canaan. Its charter also gives it the privilege of extending its lines to Lewisboro and the New York state line.

DOVER, DEL.—The Diamond State Company has been incorporated with a capital stock of $5,000,000 to conduct or promote the business of a telephone and telegraph company. The incorporators are Charles Schlegel, Arthur Rowbottom, J. Valentine Foereste and James Ross, of Jersey City; William L. Missimer, of Wilmington.

SALMON, IDAHO.—Articles of incorporation have been filed for the Hydro-Electric Mines & Power Company. The capital stock is placed at $250,000, and the incorporators are: G. B. Quaries, George W. Meitzier, W. C. Smith, J. L. Kirtley, Jr., and Roy B. Hendrom, all of Salmon.

LENA, ILL.—The Lena Electric Power Company has been incorporated with a capital of $12,000 by J. B. Hines, A. J. Clauly and others.

CLAYTON, ILL.—The Clayton Farmers' Mutual Telephone Company has been incorporated with a capital stock of $800 by C. Lewis and others.

ADDIEVILLE, ILL.—The Addieville Mutual Telephone Company has been incorporated with a capital stock of $735 by William Grattendick, C. Thoms and John Meyers.

PRINCETON, ILL.—The Princeton Light & Power Company has been incorporated with a capital of $25,000 by F. C. Dunean, H. E. Chubbuck and C. A. Trimble of the McKinley syndicate.

CHICAGO, ILL.—Articles of incorporation have been filed for the South Shore Electric Company, with a capital stock of $50,000, by Harry J. Powers, James McAdams, Charles W. Hills and others.

THE BIGLEY TELEPHONE COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $3,000, to manufacture telephone apparatus. The incorporators are H. R. Glick, E. M. Snyder and B. Samuels.

ROCKWOOD, ILL.—The Ebeneaer Telephone Company has filed articles of incorporation with a capital stock of $750. The incorporators are Wilbur H. Morgan, Joseph M. Vickers and Lewis Harry.

RUSHVILLE, ILL.—The Rushville, Pleasantview & Browning Mutual Telephone Company has been incorporated with a capital stock of $1,250 by M. S. Strong, William R. Lawler and W. M. Creer.

FRANKFORT, IND.—The Frankfort, Delphi & Northern Traction Company has been organized to build an electic railway 25 miles in length. The directors are Walter B. Cohee, Edward Spray and others.

PALMYRA, IND.—The Farmers' Metropolitan Telephone Company has incorporated to build an exchange in this city, and a system throughout Harrison County. A. N. Wolf, president, and Charles Ennis, secretary.

ELKHART, IND.—The Dunlaps Mutual Telephone Union has filed articles of incorporation with a capital stock of $10,500. The officers are: Calvin Huber, president; Henry L. Horning, vice-president; William J. Beasecker, secretary; Harvey Miller, treasurer.

INDIANAPOLIS, IND.—The Chicago, Indiana & Terre Haute Traction Company has been organized to construct an electric road to connect Lafayette, Attica and Terre Haute with the branch line to connect with Attica, Fowler with Kankakee, Ill. W. D. Bowlen is president.

CRAWFORDSVILLE, IND.—The Indianapolis, Crawfordsville & Danville Traction Company has been chartered to construct an electric railway from Crawfordsville to Covington and Danville. The capital stock is $600,000, and the directors are John J. Appel, R. I. Tood, F. M. Durbin and others.

WOLCOTVILLE, IND.—The Panama Construction Company has been incorporated to construct, equip and operate interurban railroads, also heat, light and power plants. The incorporators are: D. J. Splane, O. G. Wales and E. A. Hebberd, of 103 Washington Street, Chicago, Ill. The office of the company will be in Wolcotville.

EVANSVILLE, IND.—The Evansville & Southern Indiana Traction Company has filed articles of incorporation with a capital stock of $4,500,000. The company recently purchased the Evansville Street Car line and The Evansville & Princeton Traction Company. The company is perfecting plans for a great traction system in Southwestern Indiana.

CLEAR LAKE, IA.—The Willow Creek Telephone Company has been formed with a capital stock of $1,500.

ATLANTIC, IA.—The Walnut-Elkhorn Railroad Company has been organized, with a capital of $100,000, to build a road from Walnut to Elkhorn. John Peterson, of Elkhorn, is president.

ATLANTIC, IA.—The Atlantic Northern & Southern Railroad has been organized, with a capital stock of $150,000, for the purpose of building an interurban road from Manning to Valisca by the way of Elkhorn. J. H. Simmons is president and J. Stier, secretary.

MARSHALLTOWN, IA.—The Iowa Railway, Light & Power Company has been formed to take over the local light and railway system and to extend the interurban lines. Hamilton Browne, of Geneva, Ill., is president, and Arthur T. Browne, Geneva, Ill., secretary and treasurer.

AMITE CITY, LA.—The Central Light & Power Company has been chartered with a capital stock of $10,000. H. P. McClennon is president.

FREDERICK, MD.—The Brunswick & Middletown Railway Company has been chartered with headquarters in Brunswick, to build an electric railway between Brunswick and Middletown. The capital stock is $80,000. Electric energy for operating the road will be supplied from one of the Harpers Ferry power companies. The incorporators are: William Schnauffer, Edward C. Shafer, Outerbridge Horsey, Alonzo P. Spritzer, Frank G. House, Levin West, Charles M. Huffer, Samuel Claggett, Charles J. House, Joseph D. Ahalt, Millard F. Cook, and Dr. Arlington G. Horine.

GREENFIELD, MASS.—Articles of incorporation have been filed for the Cook Electric Company, with a capital stock of $5,000, by Charles L. Cook, Elisha H. Brewster and Lorrin D. Newhall.

WORCESTER, MASS.—The Worcester County Home Telephone Company has filed articles of incorporation with the Secretary of State for the purpose of operating an independent telephone system in the city and county of Worcester. The company starts with a nominal capital of $5,000. The company plans to expend about $2,500,000 in establishing a system in Worcester County. William H. Cook, of Worcester, is president, and Charles E. F. Marble is treasurer.

QUINCY, MICH.—Articles of incorporation have been filed for the Northeast Quincy Telephone Company, with a capital stock of $4,000.

EDENVILLE, MICH.—The Tittabawassee Power Company has been organized by Louis E. Rowley, of Lansing, for the purpose of building a dam at Edenville.

KALAMAZOO, MICH.—The Kalamazoo, Gull Lake & Northern Railway Company has been organized with Dr. J. T. Bailey, president. Work on the extension to Gull Lake will begin early in the spring.

JACKSON, MICH.—The Wolverine Park Company has been incorporated with a capital stock of $100,000 for the purpose of establishing an electric park at Vandercook Lake. George Detoir, of Lansing, is the promoter.

MANISTEE, MICH.—The Northwestern & Michigan Light & Power Company has been incorporated to succeed the Manistee Gas & Electric Company. The company will issue $500,000 in bonds for making extensions and improvements.

NORTHFIELD, MINN.—Articles of incorporation have been filed with the Secretary of State for the Northfield Telephone Company, with a capital stock of $25,000. William Ebel is president.

BREWSTER, MINN.—The Brewster-Round Lake Telephone Company has been incorporated with a capital stock of $20,000 by F. R. Geyerne, C. R. West, A. L. Wells, all of Brewster; C. Nienaber, T. Bahls, of Round Lake.

SEBEKA, MINN.—The Sebeka Telephone Company has been incorporated with a capital stock of $10,000.

PROCTOR, MINN.—The Proctorknott Water & Light Company has been incorporated, with a capital of $250,000, to install a water works and lighting system. It is stated that the supply will probably be taken from the Duluth system. The company is to build a pumping station at W. Duluth, and pump the water from there to Proctor.

BIG TIMBER, MONT.—The Big Timber Telephone Company has been incorporated, with a capital stock of $10,000, by J. S. Haley and others.

AUBURN, NEB.—The Farmers' & Merchants' Mutual Telephone Company has been incorporated with a capital stock of $5,000.

BEATRICE, NEB.—The Beatrice Gas & Power Company has been incorporated with $150,000 capital.

NEHAMA, NEB.—The Farmers' & Merchants' Mutual Telephone Company has been organized with a capital stock of $5,000. John Crother is secretary.

LAS VEGAS, N. M.—The Sacramento Telephone Company has filed articles of incorporation, with a capital stock of $10,000. The incorporators are O. M. Lee, George Duncan and J. L. Lawson, all of Alamogordo.

GREENWOOD, N. Y.—The Greenwood Telephone & Telegraph Company has been chartered with a capital stock of $2,500. C. I. Tabbetts is president.

NEWBURGH, N. Y.—The Newburgh Home Telephone Company has beeen incorporated with a capital stock of $150,000. The directors are H. J. Prince and others.

NEW YORK, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Queens Borough Street Railway Company, with a capital stock of $50,000 by C. E. Finlay and others.

NEW YORK, N. Y.—The Central Electric Supply Company has filed articles of incorporation with the Secretary of State with a capital stock of $10,000. The directors are A. Parker, G. M. Warner and G. N. Beatty, of New York.

UTICA, N. Y.—The Oriskany Hydro-Electric Company has filed articles of incorporation with the Secretary of State with a capital stock of $500,000. The directors are: G. W. Sanborn, E. H. Risley, of Utica, and M. W. Terry, of Waterville.

SALEM, N. Y.—The Soloman Light, Heat & Power Company has filed articles of incorporation with a capital stock of $50,000. The directors are John F. O'Brien, of Plattsburg; Jarvis P. O'Brien, of Troy, and W. A. Reynolds, of Whallonsburgh.

RICHMONDVILLE, N. Y.—The Richmondville, Seward & Sharon Telephone Company has filed articles of incorporation with a capital stock of $3,000. The directors are O. R. Mann, of Richmondville; Virgil Winnie, of Seward, and J. E. Preston, of Sharon Springs.

NEW YORK, N. Y.—Articles of incorporation have been filed with the Secretary of State for the South Shore Light & Power Company, with a capital stock of $10,000. The directors are J. Hinchliffe, J. C. Hinchliffe, of Paterson, N. J., and W. T. Crook, of New York.

UTICA, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Utica Southern Railroad Company, to operate an electric railway 26 miles long in Oneida and Madison counties. The company has a capital stock of $600,000, and the directors are: W. M. West, of Hamilton; M. W. Terry, of Waterville, and F. K. Baxter, of Utica.

HORNELL, N. Y.—The Steuben Traction Company, of Hornell, a consolidation of the Hornellsville Electric Railway Company, Hornellsville & Canisteo Railway Company, Canisteo, Jasper & Wood Hill Railway Company, has been incorporated with a capital stock of $370,000. The directors are Charles Adsit, of Hornell; J. W. Powell, of Canisteo, and L. D. Whiting, of Jasper.

ONEIDA, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Rome & Oneida Electric Railway Company, with a capital stock of $350,000. The proposed line will run from Rome to Oneida, with principal office of the company in Rome. The road will be 13 miles in length and actual construction will commence as soon as the necessary permission is obtained from the State Railroad Commissioners.

UTICA, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Delaware & Otsego Independent Toll Line Company, with a capital stock of $15,000. The company will build a telephone line to connect different towns in Delaware and Otsego counties. The incorporators are T. Harvey Ferris, H. A. Harrison and Delia D. Harrison, of Utica; H. D. Arbuckle, F. C. Ward, L. C. Millard and Ralph Stoddard, of Oneonta.

CLINTON, N. C.—The Clinton Light & Power Company has been incorporated with a capital of $200,000, $65,000 to be expended upon the building and equipment. Harry A. Grady is manager.

WILMINGTON, N. C.—The Wilmington Suburban Railway Company has been chartered by the Secretary of State, with a capital of $15,000, with the authority at any time to increase it to $125,000. The incorporators are M. S. and E. P. Willard and others.

ASHEVILLE, N. C.—The Asheville Rapid Transit Company has been incorporated with a capital stock of $50,000. Charles Van Bibben, of Malden, Mass., is promoter of the project. The company has purchased the Loop Line property and Overlook Park, and the line will be extended through the city to the park.

CROTON, OHIO.—The Hartford Bell Telephone Company has been incorporated with a capital stock of $10,000 by J. Potter and others.

EAST LIVERPOOL, OHIO.—The Ohio Light & Power Company has been incorporated with a capital stock of $10,000 by W. C. Supplee and others.

PIERPONT, OHIO.—The Pierpont Bell Telephone Company has been incorporated with a capital stock of $10,000 by D. M. Mallory and others.

SALEM, OHIO.—The Columbiana County Light & Power Company of this place has been incorporated by M. A. Henshillwood and others. The capital stock is $10,000.

CLEVELAND, OHIO.—The Cleveland & Sharon Electric Company has been chartered with a capital stock of $2,500,000 by E. J. Pinney, Herman G. North and others. The company proposes to construct and operate an electric railway connecting Cleveland and Sharon.

TOLEDO, OHIO.—The Interurban Station Company has been incorporated by the Toledo Railways & Light Company for the purpose of laying tracks into the proposed interurban station. The company has a capital stock of $10,000 and the incorporators are: John C. Reid, J. S. Young, William R. Hodge, W. H. McClellan, Jr., and William F. Nutt.

CHARLESTON, S. C.—The Calhoun Falls Company has been incorporated with a capital of $280,000. The officers are: Patrick Calhoun, president; Augustine T. Smythe, vice-president; H. F. Gaus, secretary and treasurer. It is stated that the engineers who are making a survey report an estimate of 27,000 horsepower. Calhoun Falls are located on the Savannah River. Smythe, Lee & Frost, of Broad Street, Charleston, are the solicitors for the company.

SIOUX FALLS, S. D.—Articles of incorporation for the Geneva & Seneca Electric Company, with a capital stock of $100,000, have been filed at the office of the Secretary of State. The new company is a consolidation of the Geneva Light & Power Company. The two companies are owned by the General Electric Company and C. F. Bloodgood, of Geneva, has been the manager. It is stated that there will be no change in the management.

RAPID CITY, S. D.—The Rapid City Traction Company has been chartered for the purpose of building a power plant on Rapid Creek at a cost of $250,000. F. N. Blockhart is interested in the project.

Legal.

CROSSING POWER CIRCUITS.—At Redding, Shasta County, California, Judge Bush, in Department 2 of the Superior Court, has made permanent the injunction forbidding the Shasta Power Company to cross its wires over those of the Northern California Power Company, its rival. A county ordinance governing the crossing of power lines compels the Shasta Company to stretch its wires fifteen feet underneath the lowest wire of the Northern Company, and at the same time keep them at least fifteen feet above the ground. As the lowest wire of the Northern is less than thirty feet from the ground, it is a physical impossibility to conform to the provisions of the ordinance under the present conditions.

CONSTRUCTION OF CONTRACT FOR SALE OF TELEPHONE COMPANY EQUIPMENT.—In a contract of sale of the entire equipment of a telephone exchange it was provided that the purchase price should be the market value of the equipment according to an inventory to be made by two experienced and reputable telephone men and that "the two men thus selected shall be the sole judges of all values." After the sale the purchasers claimed that the arbitrators selected erred in fixing the amount of wire belonging to the exchange and brought an action to recover the amount overpaid. It was held that the decision of the arbitrators as to the amount of wire involved in the sale was final and that the plaintiffs were bound by their finding. Rogers vs. Rehard, Kansas City (Missouri) Court of Appeals.

AUTHORITY OF PRESIDENT OF CORPORATION.—Where the president of a corporation guarantees the payment of a note, payable to the corporation and discounted for its benefit, the corporation is liable on the contract of guaranty though it is not shown that the president had the express authority of the corporation to act. The president of a corporation, as its agent and corporate representative, has the power, in the ordinary course of business and in furtherance of the corporate interests, to execute contracts and to bind the company in so doing. Any contract pertaining to the corporate affairs, executed by the president on behalf of the corporation, and within the general powers of such officer, will, in the absence of proof to the contrary, be presumed to have been done by authority of the corporation. George E. Lloyd & Company vs. Matthews & Rice, Supreme Court of Illinois.

CONSTRUCTION OF CONTRACT FOR RIGHT OF WAY OF TELEPHONE COMPANY.—In an action for trespass against a telephone company it appeared that the plaintiff had signed a contract under seal, in consideration of the sum of five dollars, which purported to grant to the company the right to construct and maintain its line over property owned by the plaintiff and to erect the "necessary poles along the roads, streets, or highways adjoining the property." The telephone company cut a strip averaging 24 feet in width diagonally across the plaintiff's land, a distance of over two and a half miles. It was held that the grant gave to the company the right to construct and maintain a line along the highways which ran through the plaintiff's property only and not across the land at the pleasure of the company. Morrison vs. American Telephone & Telegraph Company, New York Supreme Court, Appellate Division.

DAMAGES FOR FAILURE TO RENDER TELEPHONE SERVICE.—A practicing physician and a subscriber to telephone service was called upon to attend an employe of the telephone company to which he subscribed and was assured by the injured employe that the company would pay the bill. The medical services were not paid for and, upon receiving his monthly telephone bill, the doctor instructed the collector to have his bill for professional services deducted. Thereafter and without warning the doctor's telephone was disconnected. In an action against the telephone company it was held that the doctor could not, for the purpose of showing damage, testify that certain persons had told him that they had attempted to call him by telephone to secure his professional aid, but had been unable to do so by reason of his telephone having been cut off. Such testimony was hearsay and, therefore, inadmissible. Cumberland Telephone & Telegraph Company vs. Hicks, Supreme Court of Mississippi.

TELEGRAPH COMPANY'S DUTY AS TO DELIVERY OF MESSAGE INCORRECTLY ADDRESSED.—Where a telegraphic message is misdirected by the person sending it, the telegraph company which receives it for transmission performs its entire duty when it attempts to deliver the telegram at the address given and it is not responsible for failing to make delivery to the sendee at some other address. A telegraph company is under no legal obligation to examine directories or to make inquiries to ascertain the correct address of a person to whom a message is sent. Where a message directing the postponement of a burial could not have been delivered before the interment took place, even by the exericse of the greatest diligence on the part of the company, no damages can be recovered from the company because of a delay of two hours in delivery. In such a case the sender of the message, though he was not otherwise damaged, is entitled to the repayment of the tolls paid to the company. Klopf vs. Western Union Telegraph Company, Texas Court of Civil Appeals.

FAILURE OF TELEGRAPH COMPANY TO MAKE PROMPT DELIVERY OF TELEGRAM.—A telegraph company may establish reasonable office hours and the company is under no duty to receive, transmit or deliver messages out of such office hours, in the absence of circumstances showing an agreement to the contrary or a waiver of the regulation as to hours. Thus, where a telegraph company had a rule as to one of its offices that business hours should end at 8 o'clock in the evening, and a message was transmitted and received at that office fifteen minutes after eight, the company is liable in damages for negligently failing to deliver the message until the next morning, if it is shown that the rule as to closing the office was not ordinarily observed by the company or, in other words, had been waived by the company. A telegraph company is under a duty to deliver with reasonable promptness messages transmitted to it and where this duty is violated the sendee of the telegram may recover such damages as are the direct and proximate result of the company's negligence. Harrison vs. Western Union Telegraph Company, Supreme Court of South Carolina.

LIABILITY OF STREET RAILWAY COMPANY.—The facts in an action against a street railway company for damages showed that a passenger upon one of the defendant's cars, a boy of 12 years, upon seeing flames issue from the controller box and hearing an explosion, jumped from the car and sustained a broken leg. The other passengers, who remained seated, was uninjured. It was held that the fact that the plaintiff jumped while the others remained seated and that he would have been uninjured had he remained did not establish negligence on his part as a matter of law. An obligation rests upon street car companies to exercise the utmost care and diligence in the equipment of their cars to insure the safety of passengers and the explosion of a controller is an occurrence so unusual as to place upon the company the burden of establishing its freedom from negligence. It is not a defense that the controller was of the best and most approved pattern; that it had been inspected in the most approved manner; that there is no means known by which it can be determined in advance whether or not a controller will burn up or explode. If an inspection would not have disclosed the defect which caused the explosion then the company might well be held guilty of actionable negligence in placing upon its car an appliance so dangerous that its operation might result in injury to its passengers. A verdict in favor of the plaintiff was reversed, however, upon other grounds. Paine vs. Geneva, W. S. F. & C. L. Traction Company, New York Supreme Court, Appellate Division.

RIGHT OF WAY OF TELEPHONE COMPANY.—A telephone company erected its line along a highway, obtaining its right of way by the verbal consent of the abutting owners and under the authority of a statute of Arkansas, the State in which the line was erected. Subsequently a railroad was constructed along the way occupied by the telephone line and it acquired its right of way by purchase and conveyance from the land owners. The railroad company, after repeated demands upon the telephone company, cut down the latter's wires and removed its poles, though it appeared that the telephone line was not a nuisance and did not interfere with the operation of the railroad. In an action against the railroad company based upon its wrongful act in removing the telephone line, it was stated that a telephone line is a public utility, its public importance being recognized by clothing it with the power of eminent domain, and giving it the free use of the State's highways. It was held that the railroad company was not authorized to remove the line of telephone from its right of way and was, therefore, liable in damages for so doing. An Arkansas statute makes it a misdemeanor to wilfully and intentionally destroy, injure or obstruct a telegraph or telephone line and imposes a penalty of double the amount of damages sustained. The telephone company claimed double damages under this statute. As the railroad company acted under the mistaken belief that the telephone line was an unlawful obstruction of its right of way it was held that there was no evil intent such as is implied in the words "wilfully" and "intentionally" used in the statute and that the statute, therefore, did not apply. St. Louis, I. M. & S. Railway Company vs. Batesville & Winerva Telephone Company, Supreme Court of Arkansas.

MUNICIPAL BONDS ILLEGAL.—A decision rendered by the Supreme Court of Missouri, last week, may have a vital effect on the question of municipal ownership of public utilities. The opinion was handed down in the case of the city of Chillicothe against State Auditor Wilder to compel him to register bonds in the sum of $100,000 authorized by special election to purchase, maintain and operate a municipal electric light plant and water works. The court held that under the constitutional limit of 5 per cent, bonds could not be issued to maintain and operate municipal plants, but that the limit could be invoked to purchase or erect them. Upon this point the court decided that the Chillicothe bond issue was illegal and sustained the State Auditor in his refusal to register them. The decision states that Chillicothe already had a bonded debt of $20,000 and that the 5 per cent limit of taxation would be exceeded by the proposed bond issue for maintaining and operating the plants, whereas had the proposition for a bond issue to purchase or even to erect the plants, without the clause to maintain and operate them, been carried at an election, the issue would have been illegal. Chillicothe, through its city council, had issued a call for a second special election, January 29, to vote on the bond issue for purchasing or erecting an electric light plant and waterworks. The question has been before the people of that city for a long time. It was defeated several years ago, but carried last summer. When the bonds were issued and sent to the State Auditor for registration, he held that they were not legal and the case was sent to the supreme court to be decided.

LIABILITY OF VILLAGE TO PERSON INJURED IN STRINGING WIRES FOR MUNICIPAL LIGHTING SYSTEM.—An employe of the village of Clinton, N. Y., brought an action against the village to recover damages for injuries received as a result of the falling of the ladder upon which he was working while engaged in stringing the wires for the village lighting system. The ladder, upon which the plaintiff was working, was planted squarely upon the ground and rested against a mast arm, which projected from one of the electric light poles at a distance of about twenty feet from the ground. The plaintiff did not have a very clearly defined idea as to how the ladder came to fall, and there was no evidence tending to throw any light upon that point. The plaintiff claimed, however, that the ladder, being an ordinary extension ladder, was an improper appliance to be used in carrying on his work. He testified in a manner tending to show that a tower wagon or a ladder of different construction would have been safer. The court stated that there was nothing to show that the use of an extension ladder has been attended with peril or disaster to workmen, although it has been extensively used for a long time. The duty of a master to furnish safe appliances to his employe was commented upon in the following language: "He is not called upon to procure other devices to secure greater safety, provided those furnished by him are reasonably safe. The test of responsibility is not whether he omitted to do something that he could have done, but whether he was reasonably careful and prudent." It was held that the defendant was not negligent in providing an extension ladder instead of a tower wagon or a ladder differently constructed, or for failing to provide hooks and spikes to hold the ladder to the mast arm or a man to steady the mast arm or hold the foot of the ladder. Hart vs. Village of Clinton, New York Supreme Court, Appellate Division.

Personal.

MR. J. W. CREWS, assistant general manager of the Southern Bell Telephone & Telegraph Company, formerly located at Atlanta, has been transferred with his office to Richmond, Va., where the company has put up a new six-story steel and brick office building.

MR. JOHN R. ALEEN has been made manager of the Northwestern Telephone Company, at St. Cloud, Minn., in succession to Mr. J. W. Howitt, who has been promoted to district manager, with headquarters at Wedena, for the territory of Hubbard and adjacent counties.

MR. W. R. HAYNIE, formerly with H. W. Graber Machinery Company, Dallas, Tex., has been visiting New York City and other centers securing agencies for a full line of power plant appliances. He will open an office in the Wilson Building, Dallas, and desires to correspond with manufacturers.

MR. VICTOR TYLER.—The resignation of Victor Tyler, secretary of the Southern New England Telephone Company, is announced and has been accepted. Mr. Tyler says that his business interests are now requiring too much of his time, and that he is therefore obliged to relinquish his office with the telephone company.

MR. EDWARD R. GRIER, who for years has been assistant manager of the Bryant Electric Company, has just been elected vice-president of the Ajax Line Material Company, of Chicago. He will maintain his location in the Postal Telegraph Building at New York, looking after the eastern sales of the Ajax toggle-bolts and street-lighting specialties.

MR. E. H. MATHER has severed his connection as treasurer and manager of the Portland, Me., Lighting & Power Company, and is now located in Boston. Mr. George E. Raymond of the Consolidated Electric Light Company has been elected treasurer of the Portland Lighting & Power Company, and Mr. James A. Fleet has been appointed general superintendent of the company.

MR. HENRY FLOY, consulting electrical engineer of New York City, is now engaged in laying out a plant at Collinsville, Ill., for the St. Louis Smelting & Refining Company, which is about to triple the capacity of the power plant in its smelting works at that place. There will be installed water tube boilers, tandem compound engine direct-connected to polyphase generator, switchboard and auxiliary apparatus.

MR. C. A. DIEFENDORF, superintendent of the Northern division of the Hudson River Telephone Company, is about to sever his connection with the telephone company, for the purpose of looking after his large private business interests. Mr. Diefendorf has filed his resignation to take effect as soon as his successor can be appointed. It is Mr. Diefendorf's intention to devote his entire time to the management of the affairs of the Macdonough Shirt Company, the Plattsburg Concrete Company and his private real estate business at Plattsburg, his present home. He started with the Hudson River Telephone Company twenty-seven years ago as a night operator in its Albany exchange, and has worked himself up to his present responsible position. He went to Plattsburg as superintendent for the company in May, 1894.

MR. F. A. PERRET.—Upon the proposal of the Duke of Aosta under recommendation of Professor Matteucci of Mt. Vesuvius Observatory, and request of Minister of Foreign Affairs Tittoni, King Victor Emanuele III has conferred the cross of "Cavaliere Ufficiale of the Crown of Italy" upon Frank A. Perret of New York, for his conduct and services in the cause of humanity and science, during the great eruption of Vesuvius in April last. Mr. Frank A. Perret was nominated by the University of Naples in 1905, as honorary assistant of the Royal Vesuvius Observatory, and with Prof. Matteucci and two others remained at his post throughout the terrific eruption of the past year, making invaluable observations and photographs. This is a special honor, as the title of "Cavaliere Ufficiale" is rarely conferred upon one who has not already been decorated as simple "Cavaliere."

MR. W. J. CLARK.—Governor Hughes has announced the appointment of Mr. William J. Clark, of New York, as a delegate from this State to the national convention for the extension of the foreign commerce of the United States which will be held at Washington, D. C., beginning Monday, Jan. 14, 1907. Mr. Clark is general manager of the foreign department of the General Electric Company. For many years he has been interested in and has studied the conditions of foreign commerce and this appointment is a flattering recognition. There are few men in the United States who understand the commercial conditions, past and present, better than Mr. Clark. His book, "Commercial Cuba," is recognized as an authority on the subject. He has been a delegate to many important commercial conventions and in 1905 was a member of the United States delegation at the International Railroad Congress held at Washington.

Trade Publications.

RAILWAY MOTORS.—Bulletin No. 4473 of the General Electric Company, Schenectady, N. Y., is devoted to the GE-81 direct-current, 500-volt railway motor.

NOISELESS GEARS.—All types of noiseless gears are dealt with in an illustrated catalogue and price-list issued by the New Process Raw Hide Company, Syracuse, N. Y.

RHEOSTATS.—A well-prepared description of starting and field rheostats is contained in circular No. 1139 of the Westinghouse Electric & Mfg. Company, Pittsburg, Pa.

VALVES AND PACKING.—The 1907 catalogue and price-list of Jenkins Bros., 71 John St., New York, is a 128-page publication dealing with all types of valves and packing.

ELECTRIC SIGNS.—The Reynolds Electric Flasher Manufacturing Company, 191 Fifth Avenue, Chicago, has issued an illustrated pamphlet showing a line of "signs that attract."

ELECTROLIER SWITCHES.—The Sarco Company, 906 Sixth Avenue, New York, has issued an illustrated booklet containing suggestions for the application of "Noscru" key-arm switches to brackets, portables and electroliers.

ELECTRIC CLOTH CUTTING MACHINES.—In an artistic catalogue recently issued the Eastman Machine Company, Buffalo, N. Y., describes in detail its cloth-cutting machines which are operated by means of electric motors.

RECORDING GAUGES.—Catalogue No. 44 of the Bristol Company, Waterbury, Conn., illustrates and describes gauges for recording the pressures of all kinds of fluids. The catalogue lists standard gauges, portable gauges and round gauges.

NERNST LAMPS.—The Nernst Lamp Company, Pittsburg, Pa., has issued a neat booklet drawing attention to the beauty of the Pennsylvania Terminal Building now being constructed in New York City. This building will be illuminated by means of Nernst lamps.

ELECTRICAL MEASURING INSTRUMENTS.—All of the principal types of instruments which it manufactures are discussed in a catalogue recently issued by the Whitney Electrical Instrument Company, the general sales agents for which are Machado & Roller, 203 Broadway, N. Y.

INTERIOR TELEPHONES.—For facilitating business and reducing to a minimum the time of all transactions in residences, schools, offices, factories, etc., use is frequently made of interior telephone systems. Such systems are described in a booklet issued by the Schmidt-Wilckes Electric Company, 135 Williams Street, New York.

BOX FIXTURES.—In announcing its line of "box fixtures," which term is applied to certain fixtures that are packed in a strong cardboard box, so that there are no lost or damaged parts, the Cleveland Gas and Electric Fixture Company, Cleveland, Ohio, uses a neatly arranged catalogue each page of which represents a box in perspective.

JOHN A. ROEBLING'S SONS COMPANY, of New York, H. L. Shippy, manager, has issued a very pretty and charming folder in colors, with New Year wishes, from "Poor Richard." The picture shows two old friends watching the hands of the clock drawing nearer to the hour of twelve, while they smoke their pipes and drink a loving cup.

YELLOW JANDUS.—A yellow Jandus circular, printed in red and green inks has just been issued dealing with the lamp that is one of the trimmest known—200 hours per trim. The argument in behalf of this enclosed type of the Jandus Electric Company is well made—like the lamp—and the query may well be put, as the circular puts it, as to whether such a lamp is not the economic desideratum for every manager.

ADJUSTABLE FIXTURES.—The Gail-Webb Manufacturing Company of Buffalo, N. Y., has just issued a very neat and effective oblong pamphlet, small size, as to its adjustable electrical fixtures and portables, for office, mill and factory equipments, etc. It is well illustrated, and shows the goods up in excellent detail and completeness. As a line the apparatus may be highly commended for simplicity, elegance, convenience, etc.

AUTOMATIC TELEPHONES.—The Automatic Electric Company, Chicago, Ill., has issued a folder giving newspaper clippings to show that the chief defect in the manual system of telephony lies in the operators themselves. It is suggested that a remedy can be found in the installation of automatic telephones. A second folder of the same company shows the steps that led to the purchase of the South Bend exchange as the first and most important event in the opening of Chicago to the independent long-distance service.

ACCUMULATORS ON RAILWAYS.—The Electric Storage Battery Company, of Philadelphia, has recently issued a folder describing the application of Chloride accumulators and Exide batteries to railway signal and interlocking systems. The folder contains an interesting table showing the rapid increase in the use of these batteries for this class of work, and gives illustrations of several of the types usually employed in signal service. Illustrations are also shown of batteries of Chloride accumulators in place in semaphore towers.

TRANSITE DOORS.—H. W. Johns-Manville Company, 100 William Street, New York City, has issued an illustrated folder in regard to its "Transite" asbestos doors, intended more particularly for transformer and switch chambers. "Transite" is a fire-proof sheathing, the basis of which is asbestos fibre. It is mechanically much stronger than ordinary asbestos board, and has a density which makes the finished material practically non-absorbent, and possessed of the very highest heat-resisting properties. It will stand much rougher usage than slate, being harder and tougher and not so brittle. This material is extensively used in various ways about electric light and power plants, owing to its high efficiency, durability and the fact that it is very easily worked; being cut, nailed or screwed, very much the same as ordinary lumber.

WIRELESS TELEGRAPHY.—The Clark Wireless Telegraph Company, Detroit, Mich., has issued an illustrated circular devoted to the Clark system and calling attention to the fact that it is now soliciting business between Detroit and Cleveland, O. A long-distance station is now being erected at Buffalo, N. Y., while the factory and laboratory are busy night and day manufacturing instruments and apparatus for installation at Toledo, Ohio; Port Huron, Mich.; Mackinac Island, Soo, Mich.; Marquette, Mich.; Duluth, Minn.; Milwaukee, Wis.; Chicago, Ill.; Conneaut, O.; Michigan City, Indiana; Sand Beech, Mich.; Bay City, Mich.; East Tawas, Mich.; Alpena, Mich.; Cheboygan, Mich.; St. Ignace, Mich.; Houghton, Mich.; Hancock, Mich.; Ludington, Mich.; Petoskey, Mich.; Grand Haven, Mich.; St. Joseph, Mich.; Grand Rapids, Mich.; Lansing, Mich.; Two Harbors, Minn.; Ft. Williams, Canada; Escanaba, Wis.; Sheboygan, Wis.; Sandusky, O.; Lorain, O.; Erie, O.; Ashtabula, O.; Owen Sound, Ont.; Goderich, Ont.; Kincardine, Ont.; Collingwood, Ont.; Menominee, Wis.; Green Bay, Wis.; Manistique, Wis.; Manitowoc, Wis.; S. Hampton, Ont.; Parry Sound, Ont.; North Bay, Ont.; Chatham, Ont., and other interior points.

News of the Trade.

WILLARD BATTERY.—The Willard Storage Battery, of Cleveland, O., has opened a permanent office at room 1525 First National Bank Building, Chicago, Ill., where it will take care of its Western trade.

THE AMERICAN CONDUIT COMPANY reports a very rapid and healthy growth in its business. It has found it necessary to get larger quarters and has moved its New York office from 170 Broadway to 140 Nassau Street.

THE NEW YORK & OHIO INCANDESCENT LAMP COMPANY, of Warren, Ohio, has purchased the buildings formerly used by the Ohio Automobile Company and will take possession on February 1. This will enable the company to almost double its capacity.

THE WHEELER-GREEN ELECTRIC COMPANY, of Rochester, N. Y., has decided to enter the electrical field in Utica, and has leased the store at 10 Catherine Street. It is understood that the company will carry a large line of dynamos, motors and other electrical machinery, ready for delivery, and will also do a general contracting business and repair work, including the rewinding of armatures.

PHOENIX GLASS COMPANY.—This company on Jan. 1 moved into its new and commodious salesrooms in the Heyworth building, corner Madison and Wabash Avenues, Chicago. Complete lines of the company's quality glassware for all lighting systems are shown and the new designs for the coming season are very attractive and interesting. The company extends a cordial invitation to all interested to visit its new Chicago quarters.

THE UNITED INDURATED FIBRE COMPANY, Lockport, N. Y., is making a material which one of the large firms in this country is using to insulate pipes in an exposed position against electrolysis. The pipe is larger than 12 inches in diameter and the fibre covering is one-eighth of an inch thick. It is elastic enough to be spread apart so as to be put on the pipe and clips itself on the pipe, adhering to same snugly and firmly. The material will stand 23,000 volts without puncturing. This company states that an indurated fibre pipe with a half-inch hole and walls one inch thick will successfully resist 100,000 volts of electricity without being punctured.

CONTINUOUS OILING SYSTEM.—The following concerns have recently equipped their engine rooms with White Star continuous oiling systems: New York, N. H. & H. R. R. Co., Readville, Mass.; Texarkana Gas & Electric Co., Texarkana, Ark.; Esmonde Mills, Enfield, R. I.; J. A. Roebling's Sons Co., Kinkara, N. J.; Reading Paper Mills, Reading, Pa.; Springfield Ry. Co., Springfield, O.; Electric Developing Company, of Ontario, Niagara Falls, Ont.; Rockford Malleable Iron Company, Rockford, Ill.; N. R. & P. Consolidated Coal Company, Gentry, W. Va. The Pittsburg Gage & Supply Company, Pittsburg, Pa., will be pleased to send literature to those interested in this method of economical lubrication.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 1, 1907.
[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

839,816. ELECTROCHEMICAL APPARATUS; Frank A. Decker, Philadelphia, Pa. App. filed Mar. 9, 1905. In electrochemical apparatus, a fluid-container comprising a porous structure, said container having increasing cross-sectional areas at increasing depths.

839,817. COUPLING FOR BATTERY ELEMENTS; Frank A. Decker, Philadelphia, Pa. App. filed Jan. 22, 1906. A coupling for battery parts comprising, in combination with a plate, a device fixed to said plate and a second device for engaging and holding said first device, said devices being forced one within the other and held in close relation by the weight of the plate.

839,830. TELEPHONE HOOK-SWITCH; George D. Foster, Chicago, Ill. App. filed July 26, 1904. In a telephone hook-switch, the combination with a closed casing, of a base mounted therein and an operating-lever so pivoted on said base that it may be removed without entering the casing.

839,873. FIRE ALARM AND WATCH SERVICE SYSTEM; Judson McFell, Chicago, Ill. App. filed Dec. 12, 1905. Designed to provide non-interfering transmitters in a signal system, together with signaling devices for indicating at any suitable point by the energization of lights, annunciators or the like, the operation of any box or group of boxes in transmitting a fire signal.

839,910. TELEPHONE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Dec. 12, 1902. Relates to an arrangement of cut-off adapted to be bridged across the line during conversation.

839,928. ELECTRIC HEATING ATTACHMENT FOR HOT WATER BAGS; Charles V. Hill, St. Louis, Mo. App. filed Feb. 23, 1906. The hot water bag is made with a specially constructed stopper having a long cylindrical extension which projects into the bag and which contains a resistance bar or element.

839,935. PHASE-ADJUSTING MEANS FOR ALTERNATING-CURRENT MOTORS; Benjamin G. Lamme, Pittsburg, Pa. App. filed Feb. 6, 1905. The combination with an alternating-current motor having armature and field-magnet windings and means for supplying electromotive forces differing approximately ninety degrees in phase respectively to said windings, of automatically-adjusted means for altering the phase relations of said electromotive forces.

839,936. PHASE-ADJUSTING APPARATUS; Benjamin G. Lamme, Pittsburg, Pa. App. filed Feb. 6, 1905. Relates to modifications of the above.

839,937. METHOD OF REGULATING THE SPEED OF ELECTRIC MOTORS; Benjamin G. Lamme, Pittsburg, Pa. App. filed Feb. 6, 1905. Relates to the method of the above.

839,958. REGULATOR FOR ALTERNATING-CURRENT MOTORS; Clarence Renshaw, Wilkinsburg, Pa. App. filed Feb. 6, 1905. Relates to circuit arrangements of the two-phase alternating-current generator, transformer and motor, having special field-windings and circuit connections with the transformer.

839,983. ELECTRIC FURNACE; William H. Bristol, New York, N. Y. App. filed Aug. 6, 1906. An electric furnace comprising a fused-

quartz receptacle forming a heating-chamber; an electric-heating-coil surrounding the same; and a refractory, non-conducting material incasing said coil and chamber.

839,984. THERMO-ELECTRIC GENERATOR; William H. Bristol, New York, N. Y. App. filed Dec. 2, 1905. A thermo-electric generator comprising elements of high fusing points forming a couple, and elements of lower fusing points connected thereto, and means adapted to compensate for the effect of variations of temperature at the junctions.

839,985. THERMO-ELECTRIC GENERATOR; William H. Bristol, New York, N. Y. App. filed Dec. 26, 1905. Relates to modifications of the above.

840,001. METHOD OF REGULATING ALTERNATING - CURRENT MOTORS; Benjamin G. Lamme, Pittsburg, Pa. App. filed Feb. 6, 1905. The method of maintaining approximately constant phase relations between the currents in two circuits, which consists in varying the phase relations of the applied electromotive forces approximately in accordance with the variations in the amount of current traversing one of the circuits.

840,002. DUPLEX TELEGRAPH; Joseph W. Larish, New York, N. Y. App. filed Aug. 29, 1906. Telegraph system having differentially wound magnets at each end of the line, one of which is balanced and the other unbalanced in a special way so as to be operable from a single battery.

840,005. TESTING DEVICE; Asa M. Mattice, Milwaukee, Wis. App. filed Jan. 11, 1906. In order to prevent the journal bearings of motors wearing so much as to permit the armature to rub against the pole faces, the patentee has an electric contact device which engages the armature to close an alarm circuit in case of excessive looseness or play thereof.

840,009. APPARATUS FOR ERECTING AERIAL CABLES; Ralph S. Peirce, Chicago, Ill. App. filed Feb. 27, 1905. The pole which supports the conductor receives a sheet metal hook bent to the rounding form of the pole so as to secure stiffness and rigidity.

840,013. CONTROLLING ELECTRIC POWER DISTRIBUTING SYSTEMS; Joseph L. Routin, Lyon, France. App. filed Sept. 2, 1904. A special form of regulator having connections with the engine governor and also with a motor device in the circuit of an auxiliary generator, the effects of which are combined to vary the resistance of the field of the main generator.

840,014. ELECTRICAL PLUG RECEPTACLE; Frank J. Russell, New York, N. Y. App. filed Feb. 13, 1906. A lamp receptacle adapted to be secured to a sheet metal base for electric signs, etc. The threaded shell and the central stud terminals are on separate blocks which are only assembled together when the device is placed on the sheet metal support.

840,018. APPARATUS FOR SEARCHING OF SUNKEN BODIES; Max Von Schoultz, St. Petersburg, Russia. App. filed May 18, 1899. A sub-marine apparatus having inductance windings in a telephone circuit which indicate the position of torpedoes by the magnetic inductance thereof.

840,028. LIGHTNING-ARRESTER; Matthew O. Troy, Schenectady, N. Y. App. filed March 30, 1903. A lightning arrester having a plurality of carbon cylinders which are assembled in proximity to one another so as to provide several gaps for lightning discharges.

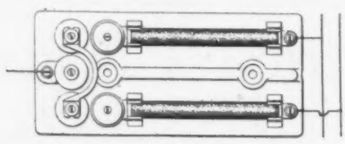
840,036. LIGHTNING ARRESTER CONNECTION; Edward A. Baldwin, Schenectady, N. Y. App. filed Aug. 8, 1904. An arrangement of circuits adapted to protect a transmission line from abnormal voltages arising from any source, whether from atmospheric conditions, or from resonance.

840,044. METHOD OF ELECTRICALLY HEATING MATERIALS; Clarence L. Collins, 2d, Niagara Falls, N. Y. App. filed Dec. 1, 1905. Relates to a method of electrically heating materials, particularly those which are poor conductors of electricity. In order to distribute the heat uniformly through the entire mass, the patentee has alternate zones or layers of resisting material through which the current is forced to pass.

840,060. HEATING ATTACHMENT FOR HOT WATER BAGS; Charles Van D. Hill, St. Louis, Mo. App. filed Nov. 15, 1905. Construction of hot water bag having a special form of resistance element, comprising a rod of insulating material spirally wound with resistance wire and included in a cylindrical step which projects into the bag.

840,066. CONDUIT; Louis A. Jones, Cambridge, Mass. App. filed Oct. 17, 1904. A flexible iron conduit composed of sheet metal strips which are woven together into tubular basket form.

840,068. PANEL BOARD FOR ELECTRICAL DISTRIBUTION; Edward N. Lake, Chicago, Ill. App. filed July 24, 1905. Details of



840,028.—Lightning Arrester.

construction of a form of panel board having watt meter connections for the various extension circuits.

840,069. TELEPHONE-TRANSMITTER; Alfred Larsson, Buffalo, N. Y. App. filed Jan. 23, 1906. In a telephone-transmitter, the combination of a transmitter-diaphragm and means for retaining the same in position comprising a ring having an enlarged periphery adapted to rest upon the diaphragm.

840,087. CONTACT-SHOE FOR ELECTRIC RAILWAYS; Henry C. Pellow, Batavia, Ill. App. filed Nov. 9, 1905. The contact shoe has jaws to engage the third rail on both sides and which are spring impelled toward one another.

840,095. AUTOMATIC SIGNAL; Judson Shoecraft, Eskridge, Kan. App. filed Apr. 20, 1906. An electric signaling system having track rails divided into sections and energized by batteries. Only one signal is used at each station and is adapted to move into different positions for danger and caution signals.

840,129. HOISTING MACHINE; Arthur E. Handy, Providence, R. I. App. filed Mar. 27, 1906. A hoisting motor including the gearing and hoisting drum, which has direct lever and link connections to the starting resistance of the motor.

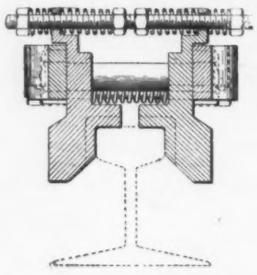
840,135. SIGNAL APPARATUS; W. Britton Lane, Evanston, Ill. App. filed July 25, 1906. A pair of special rails or trolleys are laid between the usual track rails and contact with depending shoes on the locomotive. Is arranged to complete alarm circuits in the locomotive and to exhibit signal lamps along the road.

840,150. TRANSFORMER; Walter S. Moody, Schenectady, N. Y. App. filed Dec. 16, 1901. A special arrangement for connecting a transformer to a line, specially three-phase circuit, to facilitate the mechanical construction of the transformer, and also to obtain a transformer with windings adapted for interchangeable connection on different supplied voltages.

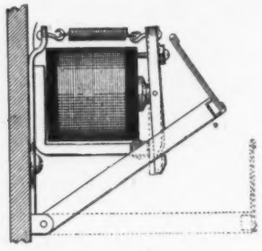
840,159. ELECTRICAL SIGNALING APPARATUS; John D. Peachey, East Orange, N. J. App. filed Jan. 10, 1903. A combined fire signaling and police signaling box. Among other features has a shutter which is moved to positions to exhibit fire or police inscriptions on the box, depending on its connection for use.

840,163. CONTROLLING MEANS FOR FLUID RESERVOIRS; Jacob L. Schureman, Chicago, Ill. App. filed Jan. 16, 1906. A system of controlling the motors of an air-compressor installation, including a pressure gage with specially constructed means adjustable thereon for closing a circuit when the usual pointer indicates any predetermined pressure.

840,182. PENDANT SWITCH; Herbert C. Wirt, Schenectady, N. Y. App. filed Aug. 3, 1903. Details of construction of a pendant switch



840,087.—Contact Shoe for Electric Railways.



840,201.—Electromagnetic Signal.

designed to have few and simple parts and be cheap to manufacture.

840,186. MOTOR-STARTING RHEOSTAT; Paul H. Zimmer, Schenectady, N. Y. App. filed June 28, 1905. In order to prevent injury to the rheostat contacts by the arm moving backward by reason of a momentary no-voltage condition, the patentee has the rheostat arm normally at its zero position in use, the motor circuit being completed by another switch.

840,200. SWITCHBOARD CORD REEL; Edward B. Craft, Chicago, Ill. App. filed Feb. 13, 1906. Reels are arranged in the operator's cabinet and which have flexible cords thereon arranged in a special way to permit of movement of the reels notwithstanding the cord connections therefrom to a fixed point.

840,201. ELECTROMAGNETIC SIGNAL; Henry M. Crane, New York, N. Y. App. filed June 8, 1904. A trip or shutter is supported above a magnet and is released to fall by a detent constituting the armature of the magnet.

840,216. SYSTEM OF ELECTRICAL DISTRIBUTION; Rudolf Hundhausen, Wilmersdorf, near Berlin, Germany. App. filed Feb. 19, 1900. A construction of base or block adapted to support fuse plugs and to receive terminal connections of an extension line.

840,222. ARC-LIGHT CARBON; August Kufferath, Beuel, near Bonn, Germany. App. filed Mar. 30, 1906. Arc-light carbons for the production of a powerful actinic light, characterized by the fact that there is added to the carbon one-half per cent of a metallic combination, which consists of equal parts by weight of yttrium nitrate and lead nitrate.

840,256. THERMOSTATIC APPARATUS; Karl Rostel, Monessen, Pa. App. filed Mar. 30, 1906. A form of air thermometer having means to close an alarm circuit in case of undue expansion of the air due to a rise of temperature.

840,311. ALARM FOR AUTOMATIC FIRE EXTINGUISHERS; Wm. A. Goldthwait, Melrose Park, Ill. App. filed Feb. 6, 1904. In fire extinguishers where a valve is automatically opened in case of fire, the patentee provides a sort of time mechanism by which an alarm is not given in case the opening of the valve is only momentary.

840,327. ELECTRIC SWITCH; Edward M. Hewlett and Theodore E. Button, Schenectady, N. Y. App. filed May 28, 1904. Details of construction of a magnetic circuit breaker having carbon contacts which are initially separated, and knife blade switches which are afterwards powerfully drawn apart by a toggle joint lever system.

840,335. ELECTRIC WATER PURIFYING AND FILTERING APPARATUS; Jacob A. Hyle, Altoona, Pa. App. filed Apr. 3, 1906. A filtering system including a number of tanks and passages, some of which have materials to filter the water therein and others of which have plates by which the water is traversed by an electrical current.

840,336. INSULATOR; Alfred Johnson, Quincy, Ill. App. filed Feb. 7, 1906. A form of insulator having two blocks which are grooved to receive the circuit wires between them. The groove is serrated so as to engage the insulation of the wire.

840,375. ALARM FOR AUTOMATIC FIRE EXTINGUISHERS; Frank H. Rice, Chicago, Ill. App. filed July 30, 1904. A form of liquid hour glass to secure a time mechanism for operating an alarm in case a valve in a hydraulic system opens.

840,428. ELECTRICAL SIGNALING SYSTEM; Edward R. Brodton, Atlanta, Ga. App. filed Sept. 3, 1904. Details of a signal system having a plurality of special trolley rails laid between the usual track rails and which have electrical connections to alarm devices in the locomotive.

840,431. TURBO-GENERATOR; John G. Callan, Lynn, Mass. App. filed June 8, 1906. An arrangement of turbine driven generator having specially constructed air passages directed into the casing to keep the motor windings cool.

840,432. APPARATUS FOR AUTOMATICALLY GIVING ALARM IN CASE OF BURGLARY, ETC.; James Carter, Leytonstone, England. App. filed Jan. 2, 1906. A burglar alarm having a motor operated attachment for blowing a couple of alarm whistles.

840,451. COMMUTATOR; Manes E. Fuld, Baltimore, Md. App. filed Jan. 30, 1906. The commutator segments have initially directed lugs at their extremities and which are received in longitudinal grooves in a cylindrical piece of vulcanite.